ASSOCIATION BETWEEN FRESHMAN RESIDENCE AND PHYSICAL ACTIVITY

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ABSTRACT

Purpose: To examine the relationship between freshman residence and physical activity behaviors on Indiana University's Bloomington campus (IUB).

Methods: A random sample of freshman (n=1200) were sent an email including a URL link to a web-based survey to assess their physical activity behaviors during the 2013 spring semester. Additional emails were sent via Listservs through instructors of some identified classes with freshman attendees. First year eligible students (taking ≥ 12 credit hours, living on campus, non-collegiate athletes) were asked to complete the survey for the opportunity to win a $50 gift to iTunes. Demographic variables including age, weight and height [in order to calculate body mass index (BMI)], vehicle on campus, and major were collected. Other variables assessed were related to campus residence and physical activity behaviors, including minutes per week of moderate and vigorous physical activity, active transportation, and fitness facility usage.

Results: Eighty-eight students completed the survey. Overall, 68.8% of students met the physical activity guidelines for moderate and vigorous physical activity and nearly 70% were of a healthy weight. There was no significant difference between mean minutes of physical activity by neighborhood and insufficient statistical power to detect a significant difference by residence hall at $p<0.05$. Frequency of fitness facility usage was correlated with VPA ($r = 0.284$, $p = 0.007$) and at least half of the residence halls were located further than 0.25 miles away from a campus provided fitness facility.

Conclusion: Neighborhood does not seem to be associated with physical activity participation. A statistically significant relationship could not be ascertained by residence hall due to inadequate sample size. Future research should include obtaining a larger sample size and further analysis of additional social and environmental factors.

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SECTION I. INTRODUCTION

Obesity is a well known health problem, which has been associated with increases in public health care costs as it relates to many chronic conditions including cardiovascular disease and diabetes.[1,2] To date, approximately 35% of the adult population are considered obese.[3] These rates appear to be consistent even among younger adults, with evidence suggesting that 35% of the college population may be overweight or obese.[4-7] Physical activity is a preventive behavior that may not only mitigate obesity, but can also lead to other health benefits including reducing risk of chronic disease and mortality.[8,9] However, less than half of adults and only 50% of college students are meeting physical activity guidelines for Americans of 150 minutes of moderate and/or vigorous physical activity weekly.[4,10,11]

It is evident that adults are not active enough, and that over one-third of the adult population is obese. More alarmingly, these trends seem to be mimicked in younger adults, specifically the college population, where evidence suggests that college students are also at risk for developing chronic disease.[12] Because of these trends, researchers have investigated weight gain and weight related behaviors during the transition to college and during the college years. [13-16] Overall, studies have seen an increase in weight in college students, particularly over the first year of college, and a decrease in physical activity. [5,13,14,17-22] Obesity is primarily due to an imbalance between energy expenditure and energy intake related to inadequate physical activity and poor diet.[2] However factors that may be associated with this relationship are more complex, including individual characteristics and behaviors, as well as environmental factors that may contribute to the development of obesity.[23,24] Understanding these additional factors that influence health behaviors related to obesity, like physical activity, may provide evidence to address obesity and inactivity trends specifically in the college population.

Environmental and social factors have been associated with physical activity and food choice, which are often related to their availability in neighborhoods.[23,25] Studies provide evidence that the built environment can impact physical activity both positively and negatively.[23] For example, research suggests that individuals with greater access to parks, gyms, or trails are more likely to be physically active.[26] For the college population, the college campus provides a unique environment through its policies, onsite resources and overall layout and design. The college campus may provide opportunities for physical activity (onsite recreational facilities) or through elements such as street and sidewalk connectivity that may influence active and non-active commuting (e.g. walking, taking the bus).

The environment of the college campus may influence and help develop health behaviors, including physical activity that college students may establish and carry into adulthood.[5] A few studies to date have investigated the influence of the college campus, including finding associations between on campus housing and weight gain, on campus residence associated with greater physical activity, as well as distance traveled to campus influencing minutes of moderate-to-vigorous physical activity. [27,28] [29-36] Although the studies to date have primarily focused on health behaviors associated with weight gain between students residing on campus versus off campus, [27,33,35] some researchers are beginning to investigate the influence of specific residence on weight gain and weight related behaviors. [28,37] Specifically, eating and exercise behaviors among freshman residing in campus provided housing have been examined, finding both weight gain and weight related behaviors varied across campus dormitories.[28] Although there is minimal research investigating the association between specific campus residence and physical activity behaviors, it is evident that living environment plays a role in weight gain and more specifically physical activity behaviors in the college population. In addition, the recent findings provide evidence that not only the college campus, but also the

residence location on the campus may be related to health behaviors. Thus research is needed to further determine if there is an association between residence and health behaviors, such as physical activity, to provide evidence on how the infrastructure and overall environment of a college campus may influence health behaviors.

Study Objective

Indiana University requires that all incoming freshman (~7,500) live in university provided residence halls. Research suggests that the transition to college and change in environment, including on campus residency, may play an essential role in determining health related behaviors, such as physical activity.[16,27,28,30,38] Thus the purpose of this study is to investigate the association between residence during freshman year and physical activity at Indiana University.

Indiana University's campus covers approximately 2,000 acres and as of the 2012/2013 academic year had 20 residence centers spread throughout. Currently, two recreational facilities [Student Recreational Sports Center (SRSC) and Wildermuth Intramural Center (WIC)] are provided for all students, in addition to private facilities in some residence centers and/or buildings. Investigating physical activity patterns on campus may offer insight into where students who are most active live, and if that residence is associated to proximity of recreational facilities. Thus specifically, this study seeks to investigate:

1) the association between residence and overall physical activity participation

2) the association between residence and fitness facility usage

3) the association between residence, frequency and distance traveled to campus buildings and mode of transportation

SECTION II. REVIEW OF LITERATURE

Background and Significance

Obesity is a considerable health problem that drastically increases social, medical, and public health related costs, particularly since it is related to many chronic conditions including hypertension, cardiovascular disease, diabetes, dyslipidemia, and metabolic syndrome.[2,9,18] Prevalence of obesity has been increasing in adults and children, and recent data from NHANES reported that 35.5% of adult men and 35.8% of adult women were obese, and 9% of children were obese from 2009-2010. [39,40] Additionally, 35% of college students may be overweight or obese, with the sharpest increase in obesity observed in those 18-29 years of age. [5-7] In a recent cross sectional survey of college students, nearly 10% of college men (3% of college women) had metabolic syndrome and with more than half of these college student men and women having at least one risk factor associated with metabolic syndrome, these rates of overweight and obesity seen in college students put them at risk for developing chronic conditions earlier in adulthood.[12]

Physical activity can be a preventive behavior for many chronic conditions and has been associated with a decreased risk in obesity, cardiovascular disease, and diabetes. [9,24,41] Further, research suggests that maintaining a high level of physical activity over 20 years is associated with smaller gains in weight.[42] In addition, data indicates that physical inactivity and poor diet were the second leading cause of death in 2000.[9] For health benefits, the Centers for Disease Control and Prevention recommend accumulating 150 minutes of moderate and/or vigorous physical activity, however, 45% or more of adults in the United States do not meet this weekly recommendation for physical activity.[10,11]

Physical activity can elicit health benefits even for younger adults. In a study of young adults, those who were more physically active as compared to those who were

less physically active had a reduced risk of incident hypertension over 15 years of follow up.[43] Alarmingly, although 70% of high school students participate in recommended amounts of vigorous physical activity, only 47-50% of college students are accumulating the recommended quantity of physical activity, with the sharpest decline in physical activity between adolescence and young adulthood.[4,20,41,44,45] Even further, a meta-analysis investigating the prevalence of physical activity of university students found more than 50% are not active enough for health benefits.[46]

As young adults transition from their childhood homes to living on a college campus they have increased autonomy in decision making, yet this is influenced by their residential placement, which is transient throughout the college years.[16] Even with strong intentions to participate in physical activity, college students may be influenced by the location of their residence and the peer group within their college dormitory. Thus, health outcomes such as physical activity may be associated with exposure to certain college residences, which are influenced by the physical placement of the dorm, the infrastructure of the dorm, and the social norms and social networks developed in and within a particular dorm. Ultimately college students are shaping many of their adult behaviors and developing their self-identity, which may be influenced by the social norms and new social networks they are integrating into during their freshman year of college within their new living environments on campus.

The Role of the Environment in Physical Activity Behaviors

Studies have begun to investigate the effect of the built environment, which is commonly defined with respect to the urban design; how the land is used and the transportation system within the geographical space. Studies provide evidence that the built environment is related to obesity, diet and physical activity, and can impact these factors, such as physical activity, both positively and negatively. [23,47] The built

environment and social support are linked and influence health outcomes.[48] Research describes the association between community level factors such as the built environment, resources influencing social integration and social support including resources available within the social network, as social determinants of health that may influence health outcomes.[48] Further, a different framework described the determinants of physical activity and eating behaviors, including societal layers, lifestyle, and behavioral settings that may influence physical activity.[23] Specifically, lifestyle encompassed those actual behaviors an individual participates in that are visible to others, which may be influenced not only by the individuals wants/needs, but also what they believe others expectations are, while the behavioral setting was the actual setting in which a behavior was completed.[23] Perhaps the most influential was the societal layer of the framework, encompassing those acquired values and beliefs through which an individual views society and through which society views the individual. This social role is delivered through the social trends, norms, values, and social relationships with which an individual self-identifies within the larger social environment. When considering this latter framework, these particular constructs may relate to the overall environment of a college campus, and more specifically, the dormitory residence on a college campus.

Environmental and social factors have been associated with physical activity and food choice, which are often related to their availability in neighborhoods. [23,25] Neighborhoods have been linked to physical activity in regards to perceptions of safety, access to fitness facilities, and walkability.[23] In this way, the neighborhood environment (access to physical activity) can influence individual health outcomes beyond individual health risk factors. For example, those that live in neighborhoods with more physical activity resources such as sidewalks and safe streets have reported higher levels of physical activity, however more research is needed to investigate not only the presence of supportive environments but also environmental barriers. [8,23]

Because college campuses are often designed to provide all needed resources, they can create their own “neighborhood”, which is not only influenced by the physical structure and environment, but also by the individuals residing on campus. There is evidence that indicates that on campus residence may be positively associated with physical activity behaviors, but negatively associated with healthy eating. [27,28,30,38] Ultimately, it is evident that the living environment influences physical activity in the college population, yet further research is still need to investigate the association between campus residence and physical activity behaviors.

Investigating the Environment and Physical Activity

Geographic information system (GIS) is a computer-based system comprised of spatial data, maps (models), and tools for conducting spatial analyses.[49,50] GIS allows for investigation and analysis of spatial data that may be linked to other outcomes.[50] Thus, GIS can provide a mechanism for investigating the relationship between people, health related risk factors or outcomes, and the physical and social environments in which they live.[50,51] Because the built environment considers how our physical environment is designed (how the land is used, the transportation system, and resources available within a geographic space), GIS has become a valuable tool in understanding the association between the patterns of activity (where people go, how they get there, what resources they access) and the design of the physical environment (what resources are or are not available and how people travel), to investigate spatial associations between elements of the built environment and specific health risks or outcomes.[50-53]

In particular, research has begun to focus on investigating the effect of the built environment on obesity and physical activity.[24,47,54] Many studies have used GIS to explore the association between different environmental factors that may influence obesity and physical activity including access to food, availability of recreational facilities,

and the impact of safety.[24] In addition, GIS may also be used to determine if health related behaviors are clustered within a certain geographical area.[54]

For example, studies have investigated the relationship between accessibility to certain foods in specific neighborhoods.[55-57] Research has explored the relationship between supermarket density and availability of healthful foods, as they relate to diet and other health outcomes.[55] In one study, ArcGIS software was used to determine travel time (by road-based network distances) to the closest grocery stores in each study zone, demonstrating how GIS provides a method to consider not only proximity but also analysis of other attributes within an environment.[58] In another study, spatial data was used to measure block distance to the nearest supermarket for each neighborhood included in the study.[56] GIS was used to identify supermarkets within a defined buffer and spatial analysis techniques including Moran's I (to test for spatial autocorrelation) were used to determine if there was a true association between neighborhood racial composition, poverty and accessibility to supermarkets.[56] Other researchers investigated the food environments near schools using buffers and spatial clustering analysis (multi-type K-function), suggesting that clustering of fast-food environments near schools within walking distance is possibly exposing students to an obesity-promoting food environment.[57]

Research has also begun to investigate environmental influences on physical activity using GIS, such as investigating the effect of distance to recreational facility or access to recreational facilities.[59-61] Using ArcGIS software, one study determined the distance between origins and recreational facilities (including informal spaces such as parks) to investigate the effect of the physical environmental on physical activity participation as compared to personal or social factors.[60,61] Other researchers utilized GIS to determine buffers to capture each subject and their relevant recreational facilities.[59] Their results suggests that differences in access to facilities exists and that

this could be associated with lower physical activity participation in certain groups.[59] Others have also used clustering analysis (Moran's I) to investigate the influence of the built environment on obesity and physical activity and found that there was moderate clustering within individual neighborhoods.[54]

Using GIS to investigate the effect of the physical environment on health risk factors and outcomes is relatively new, however it offers a mechanism to not only map and investigate the built environment but also to determine if patterns are statistically significant.[54] Further, with some research suggesting that physical activity and obesity cluster on a more local level, research is needed to understand specific neighborhood features, such as those within a college campus, that may impact these health outcomes and behaviors.[54]

The College Population

Weight and Physical Activity Changes in College Students

College students are in a transitional period of life when they are establishing their own health behaviors which they will carry into older adulthood.[5] This transition from high school to college offers the opportunity for young adults to determine their own lifestyle and health related behaviors as they establish their own self identities.[16] Because of the increasing prevalence of obesity in children and adults, researchers have investigated weight gain and weight related behaviors during the transition into college and among the college years.[13,15,62] The first year of college, during the initial transition into college life, may be the most critical as the greatest increase in weight, and consequent increase in weight status (to overweight or obese) has been seen.[18,21,62]

Studies have focused on change in weight over the college years, particularly the freshman year.[5,13,18,19,22,35,41] Researchers measured the weight of 135 freshman students in September and December of their first semester of college, and found an

increase in weight and in the proportion of students categorized as overweight or obese within the first semester of college.[18] In addition, a subset of this sample was measured again in May, and the percentage of students defined as overweight or obese nearly doubled from the baseline measurement in September. Similarly, researchers assessed body composition in a cohort of freshman during the last 3 weeks of September and again in April. Although only 31% of these students completed the follow-up measurements in April, a mean change in body weight of 2.86 (+/- 8.8) pounds was found.[19]

Previous research has not only focused on weight changes but also weight related behaviors such as physical activity during the college years.[6,13,16,62-67] Researchers assessed weight change and weight related behaviors in a sample of freshman (n=193) where diet, physical activity, weight, and BMI were assessed all via emailed questionnaire.[66] Overall, a significant increase in weight and BMI was observed over a 6-month study period. Those who were classified as overweight initially were twice as likely to have gained weight at follow up. In addition, men were nearly twice as likely as women to be classified as overweight at follow-up. This study did not find a significant association between total physical activity participation and weight change over the study period, although students with a high frequency (defined as $\geq$ 4 times weekly) of low intensity physical activity were twice as likely to have a healthy BMI (defined as BMI< 25.0) than those who exercised at a low or moderate frequency. This is similar to other findings where a 2.4 kg increase in weight was observed over a 6 to 7 month study period.[63] Although dietary intake did not increase and vigorous physical activity did increase, the researchers concluded that moderate physical activity not only decreased but was also a predictor of final weight.

In a similar study, weight change, physical activity, and dietary behaviors were investigated over the freshman year for a sample of college women.[13] Interestingly,

those that gained weight, also had a decrease in caloric intake similar to those that did not gain weight, suggesting that a reduction in physical activity is an important factor in weight gain over the freshman year. Participants were assessed in September of their freshman year and again in September of their sophomore year of college, however they were only asked to complete physical activity and food logs during their freshman year. Overall investigators found that among those individuals who lost or gained weight during their first year of college, all equally decreased their caloric intake, suggesting that physical activity may be a plausible explanation for why 66% of their sample gained weight.

In conclusion, research to date illustrates changes in weight seen in the college population, particularly over the freshman year of college. Even further, it suggests that substantial weight gain can occur within the first semester of the freshman year. Although it is clear that nutrition, eating behaviors, and other factors may play a role in weight gain in freshman college students, these studies provide evidence that physical activity may play a prominent role in mitigating weight gain in college students regardless of other factors.

Role of Physical Activity in College Student Health

Overall, an increase in weight has been observed with an increase in physical inactivity in college students.[68] Some studies suggests that dietary intake may not be as influential on increases in weight in college freshman women as the decrease in physical activity.[17,63] Interestingly a national survey of college students found that meeting the physical activity guidelines for moderate and vigorous physical activity was associated with other protective health factors including a healthy BMI, adequate daily fruit and vegetable consumption, and positive perceptions of health.[4] Overall, many college students are not active enough; a meta-analysis of college students' physical activity

behavior found that 40-50% of college students are inactive, and national data indicates that only 50% of college students are meeting the recommendations for physical activity.[4,20]

Research has found that college physical activity behaviors may persist into adulthood. Current physical activity behaviors of recent college alumni were associated with physical activity behaviors of their senior year of college, illustrating the impact this transitional period has on enabling the development of health related lifestyle behaviors, during and after college.[69] However, in a sample of college students assessed during their freshman and senior year, students not only gained weight but approximately one-third of the sample did not meet recommended guidelines for physical activity during either year.[65] Overall, a decline in physical activity has been observed in college students, particularly over the first year of college.[13,29] This increase in weight and decrease in physical activity has been reported in particular during the freshman year of college, even when college students have had the intention to be physically active.[29] These studies provide evidence that physical activity is not only related to other health behaviors in college students, but that physical activity declines over the freshman year, making the freshman year an important factor in beginning to establish healthy lifestyle related behaviors that may continue through out college and into adulthood.

The College Environment

Students' physical activity behaviors may also be influenced by the infrastructure and social factors determined by their college residence on a college campus. College students' benefits and barriers have been investigated by many researchers, and common themes persist.[64,70] College students' enablers for healthful weight management included social support and an environment that supports physical activity, however similar social and environmental situations were also found to be barriers.[64] A

factor analysis investigating perceived benefits and barriers of physical activity determined that ten factors collectively accounted for 38.9% of the variance, and among them, social benefit (moderate) and lack of peer interest were significantly correlated with (strenuous and moderate) physical activity.[71] Even further, other research found that those who did not exercise would begin to exercise if they had a workout partner/group or the location of the exercise facility was better.[70]

Focus groups among college students have provided additional insight into the complex relationship between motivations, self-regulation, and the unique social and physical environment that is part of college life, where overall the college environment supported them in participating in physical activity through providing ample opportunities.[30] Further, while social support from friends to keep them motivated and participating in physical activity was positively associated with physical activity, the transition to college and adjusting to workloads, making new friends, and time management were reported to be negatively associated with physical activity. Other evidence suggests that social and environmental barriers influence physical activity participation, including length of commute to campus, new friend networks and social situations, as well as lack of awareness and understanding for physical activity opportunities.[29] This suggests that physical activity participation may be associated with the social norms of a peer group, social support of the peer group to exercise, and the infrastructure to offer opportunities for physical activity.

It is known that self-efficacy plays a role in physical activity and exercise behavior.[17] However, self-efficacy may be influenced by the social network and social integration experienced by an individual at college. As young adults transition from their childhood homes to living on a college campus they have increased autonomy in decision making, yet this is influenced by their residential placement, which will not remain stable throughout their years at college.[16] Strong intentions to participate in

physical activity may be mitigated by location of and peer group within the college dormitory residence. Furthermore, they are in the process of developing their self-identity, which may be influenced by the social norms and new social networks they are integrated into during their freshman year of college.[16] This is further supported by evidence suggesting that college students determinants of physical activity are social support from friends, where the transition to college and the importance of making new friends and establishing new social connections, may be positively or negatively associated to physical activity participation.[29,30] Thus, health outcomes may be associated with residence in the freshman year, and consequent years by changing support systems and by shifting and evolving interpersonal and social influences.[16]

Social norms or beliefs may be associated with clustering of health behaviors among social contacts, and these social norms are particularly powerful determinants of eating and physical activity behaviors in young adults.[72] For example, one study found that induction of a social norm of overeating among college aged students led to overeating among other college aged participants.[72] Similarly, social norms for healthy eating and physical activity were associated with healthier eating and physical activity participation. Even among older adolescents, not only higher internal motivation but also active friends was associated with more physical activity.[73] Thus social influence may be a powerful determinant of health behavior, and for college freshmen, this social factor may largely be impacted by residence on the college campus as it relates to overall social norms of that residence.

These social norms may be associated with the residence building itself as well as dorm-mates and floor-mates in addition to the overarching social norms of the campus. When examining social influences on overweight and obesity, those who were overweight or obese were more likely to have overweight best friends, yet when considering social norms, perceptions of social acceptability of obesity did not differ

between normal weight and overweight/obese young adults.[72] Interestingly, social norms for acceptability of obesity was the same regardless of weight status, and researchers suggest that social modeling may be more influential, that is copying the behaviors of another individual. This factor could play a role in how social norms are developed among freshman in a college dormitory, and how these social norms may direct an individual's health behaviors, such as in participating or not participating in physical activity.

Ultimately the college campus itself, may influence health and weight related behaviors, which may be due to colleges mandating on-campus dormitory housing for incoming freshman. Often considered as a covariate, college residence may itself be a factor in health related behaviors and outcomes of college students; however research to date is equivocal.[27,28,33,36-38,74] For example, on campus residents have seen higher rates of episodic drinking, alcohol dependence, and that first year college students are at the greatest risk for alcohol abuse.[74] Prior research also found that freshman college women were 2.6 to 5.2 times more likely to gain 15% or more above their ideal weight than women who did not reside on a college campus where dormitory housing was mandatory.[75] Furthermore, research has found that students living on campus as opposed to off campus have better dietary habits and are less likely to be overweight and obese. Evidence also suggests that the decline in physical activity and fruit and vegetable consumption may be heightened in those students who move off campus.[27,33] For example, in a study of college 71 college students (half residing off campus), physical activity was found to be higher for those living on campus for both male and female students, yet dietary patterns were only associated with residence for women.[27]

Each geographical area has unique elements that may facilitate or hinder physical activity participation. The college campus may be one geographical area with unique attributes, and some research has used GIS to investigate opportunities to

improve pedestrian safety on college campuses.[76] The built environment, or the physical infrastructure of the college campus may influence physical activity behaviors as well. For example, some studies have investigated the impact of the college campus as it relates to residence, campus walkability, distance traveled to campus, and mode of transportation (e.g. bus or active transportation) in relation to obesity, physical activity and commuting habits.[32-34] Further research comparing two campuses found a difference in perceived walkability and minutes of moderate-to-vigorous physical activity each week between the two campuses.[32] A meta-analysis of university students physical activity concluded that students who lived off campus were more active than those living on campus.[46]

One study has explored the association between specific residence on a college campus to weight gain and weight related behaviors.[28] Specifically, researchers surveyed all incoming freshman (approximately 1,000 students who were to be randomly assigned to one of seven on campus dormitories) at the beginning and end of the freshman year, finding similar results to prior research where physical activity decreased and weight increased over the freshman year.[13,18,20,28,41,66] Among the 43% of students who completed the initial survey during the first few weeks of the fall semester and again after finals in the spring semester, both weight gain and weight related behaviors varied among the seven dormitories.[28] Further, this study found that for women, closer proximately from dorm to a recreational facility was associated with more frequent exercise. Overall, evidence suggest that the physical environment of the college campus may influence physical activity behaviors, yet additional research is warranted to further understand if specific residence on a campus may be associated with physical activity behaviors, such as active commuting and participation in certain types of physical activity or at specific facilities.

Conclusion

College residence is a social factor influencing health outcomes of college students from an ecological perspective. College residence creates a “neighborhood” within the college campus, which is influenced by the individuals within that neighborhood and the interpersonal social networks and peer groups that are developed among those individuals. Furthermore this may lead to changes in institutional regulations and policies as well as adaptations to the physical infrastructure of the college dormitory, which may impact the community of either the dorm as a unit or the overall community campus. Through this pathway, residence may be the overall social and physical structure in which college students develop lifetime health behaviors. Health outcomes such as physical activity may be associated with exposure to certain college residences, which are influenced by the physical placement of the dorm, the infrastructure of the dorm, and the social norms and social networks developed in and within a particular dorm.

Overall, research has found an increase in weight and a decrease in physical activity during the transition into adulthood, yet investigations focused on the influence of residence on physical activity have been limited.[17,28,35,41,46] Some studies have investigated potential predictors of weight gain (in addition to behaviors) in freshman, which has included lifestyle and accommodations that may explain why freshman are not meeting nutrition or physical activity guidelines.[35] Research suggests that on or off campus residence may influence health related behaviors, including physical activity and diet and that these may be further associated with specific dormitory residence.[27,28,33] Because many universities require freshman to live on campus their freshman year, and that physical activity may decline over the college years, residing in campus provided housing, or dormitories, specifically during the freshman year may be associated with physical activity trends seen in the college population. Because the college environment

and residence are predetermined for the college student upon moving on campus, determining the association between freshman residence and physical activity behaviors can provide evidence in how to provide an infrastructure, both physically and socially on a college campus that supports physical activity. The current study will offer insight into the placement of residence centers, fitness facilities and distances to other locations on campus to investigate physical activity. GIS will provide an additional method to assess the association between residence and physical activity, helping to determine if there is a spatial relationship between freshman dormitory residence and physical activity related behaviors.

SECTION III. METHODS

A cross sectional study design was used to examine the relationship between freshman residence and physical activity on Indiana University's Bloomington (IUB) campus. The exposure variable of interest was campus residence. The outcome variable of interest was physical activity, which was assessed once via online survey.

Ethical Considerations

The study was reviewed and approved by Indiana University's institutional review board (IRB Study 1302010741, February 25, 2013).

Procedures

Sample Population Characteristics

Eligible participants were identified as (n=7570) freshmen students residing in residence halls on IUB's campus during the spring semester of 2013. Freshman was defined as first year college student attending Indiana University full time (≥12 credit hours for both Fall 2012 and Spring 2013 semesters).

Sampling

An online survey was sent to currently enrolled freshman students at IUB. As of the spring semester of 2013, there were 11 residence halls that freshman could reside. To obtain a representative sample of freshman residing across all freshman eligible residence halls, a random sample (n=50) from each of the 11 residence halls would be required for a total sample population of (n=550). A random sample (n=1200) of emails from currently enrolled first year freshman was identified and provided by Residential Programs & Services (RPS) to ensure an adequate sample size across the residencies. Previous research in this population using an online survey has seen a 40% response

rate, which is a similar response rate to other online surveys.[28,77,78] Thus given an estimated response rate of 20-40%, a sample size between 240 and 480 (approximately n=43 per dorm) from the initial sample of 1200 freshman emails provided from RPS was expected. To further ensure adequate sample size, class Listservs were also identified through Indiana University faculty teaching classes during spring semester 2013, which freshman may be enrolled.

Before beginning the online survey, students read a statement regarding the intent of the research and answered a series of questions to confirm eligibility (Appendix 1). The survey automatically discontinued if a student was not eligible. Those students who completed the survey were placed in a random drawing to receive a $50 gift card to iTunes. One username was randomly chosen for every 50 subjects that completed the survey. Those students randomly selected to receive the gift card were notified and received their gift card via email.

Inclusion and Exclusion Criteria

Indiana University requires that all freshmen live on campus their first year. To be eligible students had to be first-year freshmen age 18 years of age, enrolled in Indiana University immediately following graduation from high school in spring of 2012, and residing on campus through RPS. Those students that were still considered freshmen by credit hour or enrollment, (e.g. 2nd year freshmen), residing in the residence halls were excluded. Because mandatory training and practice associated with membership on an intercollegiate/club sports team membership at IUB would directly influence physical activity behaviors, students considered part of such teams were not eligible.

Data Collection

Two emails with a link to the online survey were sent during the second and third to last weeks of the spring semester. The first email was sent on April 24, 2013 (Appendix 2) and a follow up reminder email was sent to those students from the Listservs who did not complete the survey on April 29, 2013 (Appendix 3). The survey included up to 40 (depending upon skip design logic) questions related to physical activity, residence, and demographics (Appendix 1).

Demographic Variables

Demographic information included age, sex and major. Other demographic characteristics and potential covariates including high school sport participation, vehicle availability, height, and weight (to calculate BMI) were also assessed via the survey.

Exposure Variable: Residence

IUB's campus had 19 residence halls (11 of which freshman reside) that comprised four distinct neighborhoods on campus as of May 2013. Residence halls not only differ in proximity to locations on campus but they also offer different amenities. Some residence halls have onsite fitness facilities where others have Living and Learning Communities. Living and Learning Communities are within certain residence halls where the goal is to create an environment with additional activities and programming for students with similar interests. Examples of Living and Learning Communities include the Fitness and Wellness Living and Learning Community, which includes an onsite fitness center that is staffed hourly. Residence information was collected including residence hall (residence) and residence building (e.g., Briscoe Residence Hall, Building/Tower 1) because there are residence halls with multiple stand-alone buildings. Neighborhood was determined based on self-reported residence from

the survey as defined by RPS. Length of time living in current residence as well as awareness and use of on-site fitness facility was assessed, as these could be factors in physical activity participation. Additional residency information including residential floor and use of stairs or elevators was included in the survey for an opportunity for more detailed residential analysis. Residence address and x-y coordinates were obtained for each residence center from IUB's GIS department and used for spatial analysis in ArcMap (version 10.2).

Outcome Variable: Physical Activity

Physical activity was assessed by questions from the International Physical Activity Questionnaire Short Form (IPAQ), which included questions about amount and frequency of moderate, vigorous, and walking activity. This survey has been validated and previously used in this population.[79] Because physical activity and transportation choices may be influenced by weather, students were asked to think back to a typical week during the spring semester of 2013 when the weather was nice, providing an optimal condition for physical activity. Mean minutes per week ($min.wk^{-1}$) of physical activity, including moderate minutes per week (MPA), vigorous minutes per week (VPA) and total minutes per week (TPA), and meeting the current physical activity guidelines of 150 minutes of (moderate or combination of moderate and vigorous) physical activity per week were calculated from the IPAQ.[10,11] Location of participation in physical activity was also assessed. IUB's campus has two onsite fitness facilities available to all students, the SRSC and WIC. Information on frequency of use of these facilities and preferred location for physical activity participation was obtained. In addition, information on sport participation in high school and in college (not including intercollegiate level teams) as well as participation in physical activity classes was gathered. Lastly, active transportation was assessed. Because IUB offers free bus service to all students,

frequency of locations traveled, type of transportation used, and preferred method of transportation was also included in the questionnaire.

Analytic Methods

Survey data was downloaded and cleaned for analysis. True misses or non-answered survey questions were given a distinct code different than those questions with skip by design. In addition, outliers (+/- two standard deviations from the mean) were removed for physical activity variables only, including moderate, vigorous, and walking minutes per week thus keeping other data associated with that subject. Variable computations were needed for active travel and fitness facility usage questions. Computations included: 1) BMI calculated from self-reported height and weight, 2) favorite facility calculated from students ranked scores of facilities, where the high scores from each facility were summed, 3) active travel calculated from summing preferred mode of transportation that was active (e.g. bicycle, walk, skate/longboard, roller blade) vs. inactive (e.g. get a ride, bus, personal vehicle), and 4) average travel calculated by multiplying the sum of distance traveled by the % of time traveled to each location, divided by 100.

Statistical Analysis

Power analysis, using G*Power (version 3.1.9), was completed to determine if statistical power was reached and to assess the effect size using Cohen's d criteria.[80,81] Boxplots, frequencies, and tests of normality were conducted independently to determine normality and assess the data for outliers. Descriptive statistics were used to calculate demographic variables including age, sex, and major. Sex was considered a potential confounder as other studies of the college population have seen differences in physical activity between men and women.[20,28,82] Prevalence of meeting the physical

activity guidelines (150 minutes of moderate, 75 minutes of vigorous, or 150 minutes combined) were calculated based on minutes per week of moderate, vigorous and combination of both.[10,11]

The association between physical activity, including minutes per week and meeting physical activity guidelines, with environment related variables including residence, transportation and fitness facility use were assessed. To investigate the association of residence and physical activity, chi-square was used to investigate meeting physical activity guidelines by residence, and a one-way analysis of variance (ANOVA) was used to compare mean minutes of physical activity between residence. Binary regression was used to determine the relationship between residence and other physical activity related variables including participating or not participating in activities such as intramural sports or physical activity classes, controlling for sex and high school sport participation.

To examine fitness facility usage, correlation and linear regression were used to investigate the association of frequency of fitness facility usage and mean minutes of physical activity per week, controlling for potential covariates including sex, BMI, and personal vehicle availability. Further, chi-square was used to examine the association between fitness facility preference and residence. To examine the influence of residence on active transportation and distance traveled, binary regressions were used to assess the association between active transportation (using or not using an active mode of transportation) and residence. Correlations and linear regression were used to determine the relationship between preferred mode of transportation and distance traveled, controlling for sex, BMI, and access to personal vehicle. Pooled variable analysis may be used for grouping variables to determine if subgroups and levels can be collapsed (floor, building, residence hall, etc.) to determine at which level a relationship exists, to further increase power and decrease the number of strata. All analysis were conducted with SPSS (version 21), significance $p < 0.05$.

GIS Analysis

XY data was added for each student based on their corresponding residence. Residence halls were selected by RPS defined neighborhoods (Northwest, Northeast, Central, and Southeast), and added to the map. To assess physical activity by residence, a cluster analysis of most to least active minutes per week (MPA, VPA, walking, and TPA) by residence was conducted for physical activity by mapping the average minutes per week by residence, using quantile interval breaks. Beyond the visual depiction of physical activity on campus, a (global) Moran's I (spatial autocorrelation) cluster analysis and Gi* (Getis-Ord hot spot analysis) were used to determine if there was statistically significant clustering by residence and physical activity.[83] These analysis were selected because they determine if 1) there are areas of clustering by location as well as by values with similar magnitude and 2) if there are hotspots of high values or low values based on clustering around features, respectively. A multiple ring buffer analysis was used to determine proximity of residence halls to SRSC/WIC with consideration of physical activity minutes per week (MPA and VPA) and frequency (average days per week) of facility usage (all usage and usage of SRSC/WIC only).[83]Three buffers were used, including 0.05, 0.1, and 0.25 miles.

SECTION IV. RESULTS

A URL link to the survey was sent via email to 1200 freshman student email addresses from RPS residing on IUB's campus. Of those, 133 were non-deliverable. Due to how the survey was disseminated (via email and additional Listservs), a true response rate for the sample is unknown, as this may have enabled the survey to spread via word of mouth and through additional channels and emails.

Of those students who received the email, 116 students responded, 99 of which met the eligibility requirements and were prompted to provide their email address and consent to the study in order to continue with the questionnaire. Of the eligible students, there were 88 students who responded to survey questions and provided email addresses and were included in the analysis and drawing. Of those 88 students, 86 students completed all of the survey questions and 83 submitted the survey to confirm completion of the questionnaire. Overall, 11 of the eligible students began the survey but did not complete the questions, so they were excluded from the analysis.

To investigate effect size, a medium effect size was determined between two residences that had the biggest difference in means for MPA, as physical activity is the main outcome variable of interest. Residence "A" had 109 ± 82 mean $min.wk^{-1}$ of MPA (n=11) and residence "B" had 210 ± 218 mean $min.wk^{-1}$ (n=9). When assessed by G*Power, Cohen's d = 0.6 at 80%, indicating a medium effect size between residences. Thus, approximately 44 students per dorm would be needed to find statistical significance at 80% power, and sampled students per dorm ranged from n=2-14, with one student responding with "other" for residence hall (Table 2). Thus a sufficient sample size to detect a significant difference at $p < 0.05$ may have been reached at n=485 students, where this study sample had n=88. When the residences were collapsed into the RPS defined neighborhood categories, an effect size f of 0.1 (a small effect size according to Cohen's criteria) was found for MPA. Overall, although 10 of the 11

residences available for freshman housing were represented in this study sample, it is likely there were too few students per residence to find a significant difference at $p<0.05$, thus analysis were conducted by collapsing residence into neighborhoods, to ensure statistical power.

Descriptive statistics were computed for demographic related variables including sex, major, vehicle on campus, mean BMI, and high school sport participation (Table 1). BMI categories of underweight, healthy weight, overweight and obese were calculated from mean BMI, where 69.8% of the sample was categorized as healthy weight (Table 1). Overall, there were more females in this sample (68.6%) as compared to males (31.4%). Because major was an open-ended question, majors were coded by affiliated school within IUB (e.g. Kelly School of Business, School of Public Health Bloomington, etc., Table 1) and type of degree (e.g. Bachelor of Science (BS) or Bachelor of Arts (BA)). Students reported 33 different majors, with most (12%) indicating undecided, and of those reporting a major (n=74), 74% were pursuing a BS. Descriptive statistics were also computed for variables related to residence, including residence center and neighborhood (Table 2). Only one dorm of the 11 available for freshman was not represented in this sample, and three of the four neighborhoods represented (freshman residence halls are not included in the Northeast neighborhood).

Physical Activity and Residence

Physical activity minutes per week were calculated for MPA, VPA, walking and TPA. Outliers were removed when values were +/- two standard deviations from the mean for MPA (n=3), VPA (n=2), and walking (n=3) and TPA was then re-calculated. When boxplots and frequency distributions were re-calculated with the outliers removed, the remaining outliers had realistic values for physical activity minutes per week, and were kept within the sample. MPA, VPA, walking, and TPA were then assessed using

Shapiro-Wilk test, and were found to be non-normal at $p<0.05$. To further address issues of normality, MPA, VPA, walking and TPA were transformed by taking the square root, finding all variables except TPA still non-normal.

The ANOVA was computed for transformed TPA, finding no significant difference in TPA by neighborhood ($F(2,75) = 0.296$, $p=0.744$). Because all other physical activity variables were not normality distributed (as assessed by Shapiro-Wilk) the Independent Samples Kruskal-Wallis Test was used to test for significant difference between physical activity (MPA, VPA, and walking) and neighborhood, finding no statistically significant differences at $p<0.05$ (Table 3a). The sample size was not adequate to repeat the analysis by residence.

Overall students in this study had a mean MPA of 166.5 ± 159.0 $min.wk^{-1}$, VPA of 216.8 ± 158.4 $min.wk^{-1}$, walking of 619.28 ± 484.40 $min.wk^{-1}$, and total physical activity (TPA) minutes per week (sum of MPA, VPA, and walking minutes) of 973.4 ± 592.0 $min.wk^{-1}$(Table 3a). To assess meeting physical activity guidelines, meeting physical activity guidelines was computed by mean minutes per week of MPA, (MPA ≥ 150 $min.wk^{-1}$), by mean minutes per week of VPA (VPA ≥ 75 $min.wk^{-1}$), and for mean minutes of MPA and VPA combined (VPA + MPA ≥ 150 $min.wk^{-1}$) to determine meeting physical activity guidelines for any combination of moderate and vigorous minutes per week (Table 3b).[10,11]

Cluster analysis was completed for MPA, VPA, walking, and TPA by residence. Average minutes for each type of physical activity was mapped and clustered by quantiles with 5 categories, dividing the sample equally by the number of features (n=10). Cluster analysis of average TPA found more than 980 minutes per week in the Southwest, Central, and Northeast neighborhoods, with Collins and Teter (residence halls from different neighborhoods) having the greatest average TPA (Map 1). Interestingly, these dorms are located off of 10th street, a main road on campus, but are

also on opposite ends of the campus. Clusters of more minutes of walking were also seen in Collins and Teter, followed by Briscoe and Ashton. Again, these residence halls are within both the Northwest and Central neighborhoods (Map 2). Further, the greatest amount of average MPA per week were found in Wright, Ashton, and Eigenmann and the greatest amounts of VPA were found in Forest, Teter, and Collins (Map 3, 4). McNutt, located in the Northwest neighborhood, had seemingly higher amounts of MPA and VPA, although low sample size within each residence may have skewed these findings. Beyond the visual depiction of physical activity on campus, a (global) Moran's I (spatial autocorrelation) cluster analysis and Gi* (Getis-Ord hot spot analysis) could not be completed because of inadequate sample size and reduced strata.

Overall, 73% of students met the physical activity guidelines for vigorous physical activity, and 40.5% met the physical activity guidelines for moderate physical activity (Table 3b). A chi-square was used to compare meeting or not meeting the physical activity guidelines by neighborhood, finding no significant difference between meeting or not meeting the guidelines for MPA, VPA, or by MVPA at $p<0.05$ (Table 3b). Lastly, a binary regression was conducted to determine the effect of residence on type of physical activity participation, including college sport teams (not including intercollegiate or IU teams), college intramurals, physical activity classes, and group exercise classes offered for free or for a fee on campus, finding no significant difference in physical activity participation preference by neighborhood at $p<0.05$ (Table 3c). When the binary regression was repeated to control for high school sport participation and sex, neighborhood was still not associated with college sport ($X^2(2)= 1.053$, p=0.591), physical activity class participation ($X^2(2)= 5.320$, p=0.070), or group exercise for a fee ($X^2(2)= 5.945$, p=0.51). However neighborhood was significantly associated with intramural participation ($X^2(2)=15.397$, p<0.001), explaining 27% of the variance in intramural sport participation, and for college group exercise for no fee ($X^2(2)= 12.316$,

p=0.002), explaining 18% of the variance in group exercise participation for no fee. Thus, males were 7.077 times more likely than females to participate in college intramurals, and females were 0.187 times more likely to participate in group exercise.

In summary, no association was found between residence (e.g. neighborhood) and physical activity including: 1) minutes per week of MPA, VPA, Walking, and TPA, 2) meeting physical activity guidelines, and 3) overall physical activity participation including activities such as intramurals, physical activity classes and group exercise. Although no difference was found by residence for physical activity, evidence from the maps suggest that perhaps residence (e.g. dorms rather than neighborhoods) may vary in minutes per week of activity.

Residence, Fitness Facility Use, and Physical Activity Participation

Chi-square was used to assess the effect of residence on fitness facility use, including facility preference, favorite facility, and facility preferred category. In the survey, students were asked to rank their preferred fitness facility out of seven options. As previously stated, favorite facility was calculated based on summing the high scores for each facility, to determine which facilities ranked the highest among the sample (Table 4). Although 62.8% reported the SRSC/WIC as their favorite facility, there was no significant difference between preferred or favorite facility by residence at $p<0.05$. To further investigate fitness facility usage, fitness facility preference was collapsed into preferred category (SRSC/WIC, residence hall or other) to tease out preference between campus wide provided facilities or in-residence, however there was still no statistically significant difference by any residence related category at $p<0.05$ (Table 4).

Spearman's correlation and linear regression were used to determine the effect of facility usage and minutes per week of physical activity by MPA, VPA, walking and TPA. Frequency of facility usage was determined by summing days per week of all facility

usage, including SRSC, WIC, in-residence/onsite, or on own (e.g. in residence hall room). VPA (r = 0.277, p = 0.009) and TPA (r = 0.242, p = 0.031) were correlated with days per week of facility usage where days per week explained 8% of the variability in VPA min.wk^{-1}. MPA, walking and TPA were not statistically correlated with facility usage at $p < 0.05$. When linear regression was repeated to control for potential confounders, including sex, BMI, and vehicle availability, only fitness facility usage was significantly associated with VPA (Table 6).

A multiple ring buffer analysis was conducted to determine which residences were within a 0.05, 0.1, and 0.25 mile radius of either WIC or SRSC, to assess MPA, VPA, and facility usage within the buffer. When physical activity minutes and facility usage were depicted by residence, those residencies not meeting the physical activity guidelines for MPA were located outside of the furthest buffer (0.25 miles), including Reed and Foster (Map 4). When examining the map further, Reed appears to be approximately 0.5 miles away from the SRSC but not WIC, where Foster is located just outside of the 0.25 mile buffer. When looking at VPA, although all residencies had an average VPA greater than 75 minutes, residences with the lowest amounts of VPA were located just outside of the 0.25 mile buffer (Foster) or just inside that buffer (Eigenmann, Map 3). When examining facility usage within the buffers, two of the three residences with the highest facility usage of SRSC/WIC were located within the buffers, with Reed being the residence outside of the buffer, and at least 0.5 miles away from the SRSC (Map 5). The other two dorms were within the 0.25 mile buffer to the SRSC only. When total facility usage (including in-residence facilities) was assessed, four of the ten residences reported two days of facility usage, with one of those residences being Briscoe (Map 6).

VPA was correlated with days per week of fitness facility usage, however no association was found between residence (e.g. neighborhood) with preferred places to

participate in physical activity or favorite facility, which included on campus recreational facilities, in residence halls, or other. Overall, no distinct pattern between distance to facility and usage was found.

Active Transportation

Pearson's correlations and linear regressions were used to assess the relationship between residence and mode of transportation, including distance traveled and frequency of travel. Overall, 14.9% of students reported taking the bus, and 78.2% reported walking as their preferred mode of transportation (Table 5). Further, greater than two thirds of this sample preferred active travel, specifically walking, over other means of transportation to and from their on-campus residences to other campus buildings (Table 5).

There was no statistically significant correlation (r = -0.095, p= 0.383) or relationship (F(1,84) = 0.769, p= 0.383) between preferred mode of transportation and neighborhood. When repeated to control for potential confounders including sex, BMI, and vehicle availability, no statistically significant relationship was found (F(4,80) = 0.283, p= 0.888). A correlation was conducted to determine the association between active transportation/non-active transportation and neighborhood, and found no correlation (r=0.35, p=0.746). Binary regression was computed to assess the relationship between active/non-active transportation and average distance traveled, however no relationship was found (X^2(1) = 1.935, p = 0.164). When the regression was repeated to control for neighborhood, sex, BMI, and vehicle availability, there was still no significant relationship between active travel and distance traveled ($X^2(5)$ = 4.321, p= 0.504). Ultimately, no association was found between residence (e.g. neighborhood) and average distance traveled.

SECTION IV. DISCUSSION

Overall, 73% of students met the physical activity guidelines for VPA, yet only 40.5% met the physical activity guidelines for MPA. The MPA findings in this study are consistent with other research amongst college students, which have seen only approximately half of university students to be active enough for health benefits or have found large proportions of college students as either inactive or not meeting physical activity guidelines.[4,20,46] However, when MPA and VPA were considered together, nearly 70% of students were meeting the physical activity guidelines, as compared to 45% of the adults in the United States, and 50% of college students.[4,10] In addition, this study found slightly more students (69.8%) of the sample categorized as healthy weight, as compared to 61% nationally based on the results from the 2012 American College Health Assessment-National College Health Assessment.[4]

Physical Activity and Residence

Most of the sample resided in the Central neighborhood, followed by the Northwest and then Southeast neighborhoods, and all but one of the residence halls available for freshman was represented in this sample. However, when determining the influence of residence, no association was found between neighborhood and physical activity variables or meeting the physical activity guidelines. Although there was ample power to determine if there were significant relationships by neighborhood, it is evident from the maps, that residence halls within neighborhoods vary in their proximity to recreational facilities and ultimately in minutes per week of physical activity seen in this sample. This may suggest why no associations were found between neighborhood and physical activity, and perhaps if an adequate sample had been reached, significant differences may have been found by residence. Conversely, if these findings are believed to be true, than perhaps residence is not related to physical activity behaviors. This may be further

supported because no association was found between neighborhood and fitness facility usage or between neighborhood and mode of transportation or distance traveled. Ultimately these findings are in contrast to previously published research that found that the physical environment, including dormitory residence, can be associated with physical activity.[28,47] However the higher rates of physical activity and healthy weight in the current study may be indicative of protective or supportive factors of health behaviors on IUB's campus, but further research is needed.

Overall, there were no statistically significant differences in physical activity for MPA, VPA, Walking, or TPA between the different neighborhoods. Further, no association was found between type of physical activity participation and neighborhood. There were too few students per dorm and overall inadequate sample size to determine the association between residence hall and physical activity participation. Although no significant relationship was found by neighborhood, physical activity minutes per week did appear to differ by residence, suggesting that additional research is needed to determine if there is a significant difference in physical activity by residence hall. However, values for physical activity by residence should be interpreted with caution given the small sample size, as they may be meaningless to real physical activity minutes per week for this population. Although a statistically significant relationship was not found in this study, an adequate sample size may have been able to ascertain the impact of living in a certain residence hall, as other studies have found an association between proximity to fitness facilities and increased exercise, even among female college students.[28,59] Further, if clustering of physical activity did occur within a certain residence hall according to Gi* analysis, this would indicate that there may be some other factor associated with increased physical activity within that residence hall other than proximity and usage of facilities, providing evidence for further research into the social environment within the residence.

Residence, Fitness Facility Use, and Active Transportation

There was no association found between neighborhood and average distance traveled or preferred mode of transportation around campus or active transportation. Other research has investigated distance traveled to campus, and found differences in moderate to vigorous physical activity between campuses.[32] Further, another study found that those students living off campus gained more weight than students living on campus.[33] Although no relationships were found in this sample between neighborhood, distance traveled and mode, a larger sample may tease out differences by residence hall or additional environmental factors specific to IUB's campus.

There was no association found between residence or neighborhood with preferred places to participate in physical activity or favorite facility. Even when preferred facility was collapsed into smaller categories (facility preferred), there was still no association found between residence or neighborhood with facility preference. A correlation was found between days per week that a facility is used and minutes per week of vigorous physical activity regardless of sex, BMI, and vehicle availability. When facility usage and minutes per week were mapped, there did not seem to be any distinct pattern between distance to facility and usage, as the highest number of days of usage was within a residence outside of the furthest buffer.

Given the lack of congruent findings with respect to distance and facility use in this sample, similar research using buffers to investigate distance to recreational facilities in adolescent populations could provide insight into what buffers could potentially be translated into college campus research. For example, research among adolescents has investigated suitable buffers when considering appropriate distances to walk to recreational facilities or parks, finding that 1200m (0.75 mile) to 1600m (1.0 mile) is an appropriate distance.[84] When adolescents were asked what an "easy walking distance would be" respondents reported 15 minutes, which translates to 0.75 miles.[85]

Given this evidence, researchers determined the number of facilities within a school's buffer, and found that those schools with ≥ 5 fitness facilities within a 0.75 mile buffer had more physical activity per day.[85]Other research has also considered a 0.75 mile buffer around residence, and found that those residences with one or more fitness facility within the buffer was related to cardiorespiratory fitness in adolescent girls.[86] Availability of parks within 400m (0.25 mile), 800m (0.5 mile), and 2000m (1.25 mile) has also been investigated but no association between the availability of parks within any of the buffers and moderate-to-vigorous physical activity was found.[84]

In the present study, the dorms farthest away from the facilities were approximately 0.5 miles, yet evidence from the a literature previously described suggests that IUB residences may be an appropriate distance with respect to walking and access to fitness facilities. Yet researchers have reported a difference in exercise frequency in females, based on proximity to recreational facilities, where those closer reported greater frequency in exercise, however in the current study even residence halls 0.5 miles away may have some of the highest participation in physical activity.[28] These findings may in part be due to the fact that all college freshmen have equal access to campus provided recreational facilities as part of their tuition fees, and that campus provided facilities offer similar amenities at both locations including a track, cardio equipment, strength training equipment and aquatic facilities. Conversely, this may suggest that equal access may not be the only factor contributing to usage. In addition, Briscoe, a residence hall with an onsite staffed fitness facility, did not have the highest minutes of physical activity or the highest average frequency of usage. Ultimately, these results may not be representative, given the small sample size within each residence. Thus, it may be that availability of facility with respect to proximity of residence is adequate on campus, but other factors of accessibility such as number of

facilities, type of facilities available, and intrapersonal factors such as self-efficacy to go to the facility should be considered.

These results and other findings from research on buffers may be indicative of additional factors attributing to facility usage. Other research has seen that physical activity participation may be associated with social norms of a peer group, social support of the peer group to exercise, beyond that of the infrastructure to offer opportunities for physical activity.[72] Thus future research should consider investigating additional factors other than the physical environment that may be associated with facility usage, such as peer and social factors.

Strengths and Limitations

There has only been one other study to date that has investigated the relationship between dormitories or residence halls across a university campus. Researchers used similar methodologies to this study, including the use of an online survey emailed only to freshman students residing on campus.[28] IUB's campus differed in size from the previously assessed campus by number of residence halls and number of freshman students. However the universities are similar in design by offering two onsite recreational facilities including pools, weight rooms, and cardio equipment.

Overall 10 of the 11 residence halls available for freshman housing on IUB's campus during spring of 2013 were represented in this study and the only residence hall that was not accounted for in this sample was Wilkie, which is not routinely available for freshman. Ultimately too few students per residence hall completed the survey to find a significant difference for physical activity by residence in this sample. Due to university limitations, the time period allowed for survey distribution may be related to the study's low response rate, as the survey was sent during the last two weeks of the 2013 spring semester, including the week before and week of final exams.

Given an estimated response rate of 20-40% (which has been seen before using an online survey in this population), a sample size of up to 480, from the initial 1200 emails provided by RPS, could have been expected.[28,77,78] Further, the previous study was able to send an email to all eligible freshmen (approximately 1000, as compared to the nearly 8000 freshmen students residing on IUB's campus over the 2012-2013 academic year), and achieved an initial 54% response rate.[28] In addition, a lottery for cash prices was used to as an incentive for participation, which is similar to the random drawing used in this study. Thus, given the use of additional Listservs, it would have been reasonable to assume that a larger sample size could have been expected, and therefor enough statistical power achieved. This small sample size limited the power of the analysis to the neighborhood, rather than looking at residence halls or dorms, thus the pooled variable analysis could not be conducted, and only differences by neighborhood could ultimately be determined. The small sample size also limited the spatial analysis within ArcMap.

The purpose of using a random sample identified through RPS and other Listservs of classes with freshman was to increase the likelihood of getting a diverse sample by major and by residence. These procedures may have helped to decrease the potential for selection bias due to oversampling students interested in the fields of health and physical activity. Success of the sampling procedures is somewhat evident, in that at least eight different schools and 32 majors were represented amongst the sample, where students studying in schools related to health were not overly represented. However, this sample found overall greater amounts of physical activity and slightly higher percentage of the population at a healthy weight, which may be indicative of other sources of bias, including response bias. Students may have felt that being physically active is socially desirable (e.g. something they should be participating in) and may not have wanted to report being inactive or less active. This may have lead to over-reporting

of actual physical activity participation and preferences. Further, because the questionnaire asked extensively about physical activity behaviors, students may have felt inclined to inflate their answers or provide answers agreeable to the obvious purpose of the research as stated in the recruitment email and informed consent documentation.

Higher than predicted rates seen here may indicate that students who answered the survey were not representative of student's on IUB's campus. Although the use of a random sample helped to alleviate selection bias for those interested in physical activity or health initially (including students from different majors and schools), students who are interested in health or physical activity may still have been more likely to open the email, click on the survey, and complete the questionnaire, suggesting an additional source of bias. Ultimately the low response rate seen in this study may be attributed to non-response bias in this study; students that responded may not be representative of IUB's freshman students, where students who responded may be more active and of healthier weight than their peers. However if these rates are believed to be true, there may be potentially protective environmental factors related to the layout and resources within IUB's campus. Yet given the lack of findings in this study and potential sources of bias, it is hard to determine if the sample and findings are representative of IUB freshman students.

Although this study had limitations, it also had several strengths, particularly in its assessment of physical activity related variables. As compared to the other study, which only asked questions about frequency of exercise on an average week over the past year, this study asked questions related to minutes of moderate, vigorous, and walking minutes per week, as well as type of physical activity participation preferred, and where physical activity participation takes place.[28] In addition, more detailed questions were included about location and frequency of travel to determine average distance per week.

SECTION IV. CONCLUSION

In summary, no significant associations were found between neighborhood and physical activity behaviors and there was insufficient power to determine if there were associations by residence. Results of this study remain unclear on the association between residence halls and physical activity related behaviors on IUB's campus, particularly because evidence has been found to suggest that differences in physical activity and dietary behaviors exist based on freshman residence.[28] For example, since there was a relationship found between VPA and facility usage, and this sample had almost 80% of the population meeting the guidelines for VPA, further research is warranted to determine if this is related to residence and distance to facility, or another aspect of that residence building or its residents as it could provide evidence for incorporating more onsite facilities within residence halls. This is further supported with evidence indicating that close proximity to recreational facility was associated with greater physical activity in college women seen in the prior study.[28]

Future research should further investigate the relationship between residence hall and physical activity with an adequate sample size. In addition, implications of weather and timing of survey should also be considered. Studies assessing the influence of residence should also consider additional analysis of variables that include social and environmental and peer supports, including social norms within the residence halls to ascertain the community or neighborhood influence a particular residence hall may elicit on physical activity behaviors, particularly since no study to date as investigated the social environment which may interact with the physical environment of the college campus.[28,37] Specifically for IUB, this may help to understand why MPA minutes were lower and VPA minutes were higher within this population. Other covariates, including rules pertaining to bidding for residence centers and students prior knowledge of residence halls, living within a Living Learning Center, desire to live there, and if it was there first choice should also be considered. This is particularly important, as evidence

suggests that there are dorms that are more favorable than others, and bidding systems across universities may differ. [28] Ultimately freshman students are placed in a randomly assigned environment, theoretically not biased by choice, which provides a unique opportunity to investigate the association of the environment, both social and physical, on health behaviors.[28] Lastly, research should consider if freshman residence has an impact on establishing physical activity behaviors throughout the college years by following a cohort of students from freshman year to senior year.

Additional research is warranted to determine if IUB's students, particularly freshman, are in fact more active, and if so, what this may be attributed to including residence or other social and environmental factors, or access to specific resources and/or the overall layout of the campus itself. This is important, as other research has found differences in physical activity and active transportation by distance needed to travel to different campuses, as well as physical activity being influenced by length of commute to campus.[29,32] Because higher rates of physical activity were seen in this sample, additional research opportunities could include expanding beyond freshman students, to 1) see if these trends are stable across multiple years and if so 2) investigate the factors that may be supportive of physical activity for all students on IUB's campus including all undergraduate and graduate students. The spatial analysis, including the Moran's I and Gi*, were limited to determine if clustering was significant or random, a larger sample, including representation by residence building, may allow for more robust statistics including spatial analysis to assess patterns related to physical activity on IUB's campus.

Suggestions for Future Research

Although other researchers have seen higher response rates for online surveys in this population, the lower rate seen here warrants discussion of survey and data collection in this population. In this study, students were emailed a link to the survey, and in some cases the students were sent the email via their professor. It is possible that some instructors explained the purpose of the research prior to emailing their students, and this may have influenced a student's likelihood of participating in the study. Studies should consider in person recruiting and promotion of the research to freshman students including 1) visiting classrooms and lecture halls, 2) attending residence building meetings, and 3) participating in IUB sanctioned fairs or events that freshman are likely to attend. Researchers could potentially explain the purpose of the research to groups of students, answer any questions, and also provide mechanisms for completing the survey if desired at that time rather than relying on the student to open an email from an unknown party. These methods might further offer an opportunity to make students feel more confident and comfortable with participation in the study as well as gain a better understanding of the purpose of the research regardless of feelings towards health and physical activity, helping to alleviate sources of response bias. In addition, use of pedometers and accelerometers could further alleviate issues of response bias by objectively measuring physical activity.

Further, given all of the technological platforms, including emails and messages from course collaboration sites, online/email communication may be lost due to oversaturation within the population. Increasing response rate is paramount for future research in this population as it can help to mitigate issues related to non-response bias and help in achieving a representative sample from the population. Thus in person recruitment may be warranted to reach this population. These methods ultimately would

help in determining if the rates seen here are actually representative of IUB's campus and offer direction for next steps including campus design and planning.

Although no statistical associations were found in this study between distance from residence to recreational facility, the buffer analysis and other findings in the literature suggest that more evidence is needed when considering availability of resources, active transportation and physical activity participation.[28] For example, when buffers were used to investigate minutes spent walking for transport in adults within 400m (0.25 mile) and 1500m (0.9 mile) buffers, researchers found that destinations or recreational facilities located within a buffer (typically 0.25 mile – 1.25 miles) were associated with more time spent walking for transportation.[87] In summary, research in adolescents and adults has seen a relationship between destinations and walking behaviors, as well as a relationship between fitness facility availability within a 0.75 mile buffer and increased physical activity and fitness.[84-87] Research in the college population suggests that closer proximity to recreational facility was related to exercise frequency in females, yet distance was not quantified within a buffer or by distance.[88] Although the current study used a 0.25 mile buffer for the largest buffer when assessing access to facility, residences located approximately 0.5 miles from facilities had higher physical activity, and lower physical activity was seen in residence halls with an onsite facility; thus distance to facility in relation to physical activity remains unclear.

This evidence suggests that distance and proximity to recreational facilities or other destinations may be associated with active transportation, physical activity, or fitness. Thus, future research is needed to further tease out and determine specific buffer and distance cut points in regards to active transportation, and use of recreation/fitness facilities with respect to participation in physical activity. Researchers should consider determining what cut points on a college campus relate to usage of facilities or active transportation methods. Further, qualitative studies using focus groups

and other methods could help to understand the determinants of facility usage and active transportation on campus other than geographic distance. Determinants could include access and awareness of bus routes, walking routes, and familiarity with recreational equipment, programming and facilities. Including these methodologies could be particularly valuable given the availability of a free bus service to students and long lines often observed on IUB's campus for the buses. These findings would help to further understand transportation determinants and preferences in this population and if the results found in this study are in fact representative of IUB's freshman students. If so, assessing these factors in other years of college could provide additional insight. Because each campus is unique in its layout and size, this evidence will provide insight for recommendations on how to design a campus (including placement of facilities, resources, buildings, housing, and walking paths for connectivity) to support physical activity behaviors.

Lastly, timing of survey and assessment in this population should be carefully considered specific to the campus or college environment. For IUB students, end of the spring semester includes many events, including the Little 500 Race (which is unique to the campus) as well as final exam week. Engagement with this population is recommended before or immediately following spring break to capture a period of potentially lower stress and more regular/representative schedules and behaviors as well as to increase the likelihood of response. RPS initially worked to provide guidance in how residences are structured on IUB's campus providing a random sample of freshman student email addresses. Future researchers should consider a closer partnership and collaboration opportunity with RPS in designing and implementing studies of IUB's residence halls as well as developing relationships with leaders and committees at each residence hall or building. This may provide opportunities for focus groups, interviews, and additional survey opportunities to engage more students from

each residence hall or building providing further evidence and greater understanding of the role of residence in physical activity participation on IUB's campus.

Overall, an ideal study of this population would include 1) using objective measures for physical activity (e.g. accelerometers) and biometrics, 2) assessing social factors, including social norms and social support, 3) measuring perceived benefits and barriers to participating in physical activity 4) attaining a large enough sample to assess difference by residence hall and residence building, 5) following a cohort of students across the four college years to see if physical activity behaviors are sustained, and 6) imploring additional methods to increase response rate.

Ultimately this would provide further evidence to assess what influence (if any) residence and change in residence may have on physical activity behaviors including facility usage and active transportation and may help in teasing out if the physical environment or other factors related to the larger college community impact physical activity, specifically at IUB. Lastly, it could offer insight into other residential influences other than physical location and proximity that may relate to physical activity, including perceived benefits and barriers, and social factors that may influence physical activity participation.

Future Implications

Comparisons of college campuses can help determine best practices in environmental and social supports to optimize campuses to meet the needs of students and provide an opportunity to influence the adoption of healthy lifestyles that may translate into adulthood.[28] Additional research of IUB's campus could offer evidence to ascertain the influence of residence, to determine more precisely physical, social, and environmental factors that may be related to physical activity behaviors on IUB's campus. These could include assessing factors unique to IUB's campus, such as the free bus

system, walking routes/paths away from vehicle roadways, and the availability of two campus wide fitness facilities, as well as possible peer support and social networks intrinsic to the campus. Because active commuting has been associated with decreased cardiovascular disease in young adults, and this sample found an average 4.82 miles traveled per week with walking as the preferred mode, future studies should further investigate active transportation to and on IUB's campus across the college years.[59] Although the other campus assessed had similar recreational facilities, the campus was walking only, without campus public transportation.[28]

Overall the purpose of this study was to examine physical activity by residence, yet additional studies should also consider other covariates related to weight related behaviors such as availability and distance to dining hall, foods offered, and accessibility. Thus if IUB did have higher rates of physical activity and greater prevalence of healthy weight, the factors associated with these trends may be beneficial to other universities where supporting young adult health and aiding in development of long term health behaviors into adulthood may be a priority.

Table 1. Population Characteristics

Sample	**n=86**
Sex	
Male	27 (31.4%)
Female	59 (68.6%)
Age	18.88 (0.357)
Major (by school)	
College of Arts and Sciences	21 (24%)
Kelley School of Business	25 (29%)
School of Education	6 (7%)
School of Informatics and Computing	4 (5%)
School of Journalism	2 (2%)
School of Public and Environmental Affairs	1 (1%)
School of Public Health-Bloomington	16 (19%)
School of Social Work	1 (1%)
Undecided	10 (12%)
Vehicle on Campus	
Yes	15 (17.4%)
No	71 (82.6%)
BMI	23.53 (3.822)
BMI Category	
Underweight	1 (1.2%)
Health weight	60 (69.8%)
Overweight	20 (23.3%)
Obese	5 (5.8%)
High school sport participation	75 (78.1%)

Table entries in frequency (percent) or mean (standard deviation).

Table 2. Residence and Neighborhood of Sample Population

Sample	n=88
Northwest Neighborhood	**30 (34%)**
Briscoe	3 (3.4%)
Foster	11 (12.5%)
Collins	2 (2.3%)
McNutt	14 (15.9%)
Northeast Neighborhood*	NA
Central Neighborhood	**36 (41%)**
Ashton	7 (8%)
Eigenmann	9 (10.2%)
Teter	11(12.5%)
Union Street Center	NA
Wright	9 (10.2%)
Southeast Neighborhood	**21 (24%)**
Forest	10 (11.4%)
Read	11 (12.5%)
Rose	*Available Aug. 2013*
Wilkie	0
3rd & Union Apts.	NA
University East Apts.	NA
Other	1 (1.1%)

Table entries in frequency (percent)

**Residences within this neighborhood are primarily upperclassmen and graduate students.*

Table 3a. Analysis of Residence and Physical Activity Minutes

		Neighborhood			Kruskal-Wallis Test
Physical Activity	**Total**	***Northwest***	***Central***	***Southeast***	**p-values**
MPA min.wk^{-1}	166.51 (158.99), n=84	142. 04 (129.15)	185.44 (185.36)	165.75 (150.20)	0.893
VPA min.wk^{-1}	216.76 (158.40), n=89	204.23 (169.73)	197.73 (147.33)	266.19 (167.23)	0.283
Walking min.wk^{-1}	619.28 (484.40), n=85	600.47 (458.73)	670.15 (595.5)	626.98 (487.30)	0.928
Total min.wk^{-1}	973.41 (591.95), n=80	915.29 (582.60)	1029.52 (652.42)	1003.68 (526.95)	0.702

Table entries in mean (standard deviation) minutes per week.

Table 3b. Analysis of Residence and Physical Activity Guidelines

		Neighborhood			Pearson Chi-Square	
Physical Activity Guidelines	**Total**	***Northwest***	***Central***	***Southeast***	**$X^2(2)$**	***p*-values**
MPA ≥ 150 min.wk^{-1}	**34 (40.5%), n=84**	10 (12.2%)	14 (17.1%)	9 (11.0%)	0.439	0.803
VPA ≥ 75 min.wk^{-1}	**65 (73%), n=89**	21 (25%)	22 (26.2%)	18 (21.4%)	2.503	0.286
MVPA ≥ 150 min.wk^{-1}	**66 (68.8%), n=82**	22 (25.3%)	26 (29.9%)	17 (19.5%)	0.316	0.854

Table entries in frequency (percent)

Table 3c. Analysis of Residence and Physical Activity Preference

	Total (n=88)	**Neighborhood (n=87)**			***Binary Regression***	
		Northwest	***Central***	***Southeast***	**$X^2(2)$**	***p*-value**
Sport	**1 (1.1%)**	1 (1.1%)	0 (0.0%)	0 (0.0%)	2.152	0.341
Intramural	**15(17.0%)**	4 (4.6%)	5 (5.7%)	5 (5.7%)	1.142	0.565
Physical Activity Class	**28 (31.8%)**	10 (11.5%)	9 (10.3%)	9 (10.3%)	1.954	0.376
Group Exercise (Fee)	**19 (21.6%)**	7 (8.0%)	10 (11.5%)	2 (2.3%)	2.981	0.225
College Group Exercise (Free)	**37 (42.0%)**	12 (13.8%)	15 (17.2%)	10 (11.5%)	0.311	0.856

Table entries in frequency (percent)

****Sex B=1.957, S.E. = 0.631, Exp (B)= 7.077, p=0.002***
*****Sex B=-1.674, S.E. = 0.565, Exp (B)= 0.187, p=0.003***

Table 4. Analysis of Facility Preference

	Facility Preference			Chi-Square	
	SRSC/WIC	Residence Hall	Other	$X^2(4)$	*p*-value
Total (n=78)	49 (62.8%)	4 (5.1%)	25 (32.1%)		
Neighborhood (n=77)				6.892	0.142
Northwest	13 (16.9%)	1 (1.3%)	13 (16.9%)		
Central	22 (28.6%)	2 (2.6%)	9 (11.7%)		
Southeast	14 (18.2%)	1 (1.3%)	2 (2.6%)		

Table entries in frequency (percent)

Table 5. Analysis of Residence and Active Transportation

	Total (n=87)	Neighborhood (n=86)		
Variable		***Northwest***	***Central***	***Southeast***
Active Transportation	72 (82.8%)	26 (30.2%)	28 (32.6%)	18 (20.9%)
Mode of Transportation				
Bus	13 (14.9%)	3 (3.5%)	6 (7.0%)	3 (3.5%)
Bicycle	4 (4.6%)	1 (1.2%)	2 (2.3%)	1 (1.2%)
Walk	68 (78.2%)	25 (29.1%)	26 (30.2%)	17 (19.8%)
Get a ride	2 (2.3%)	1 (1.2%)	1 (1.2%)	0 (0.0%)
Ave Distance Traveled (miles)	4.82 (2.48)	5.23 (2.42)	4.99 (2.51)	4.93 (1.85)

Table entries in frequency (percent)

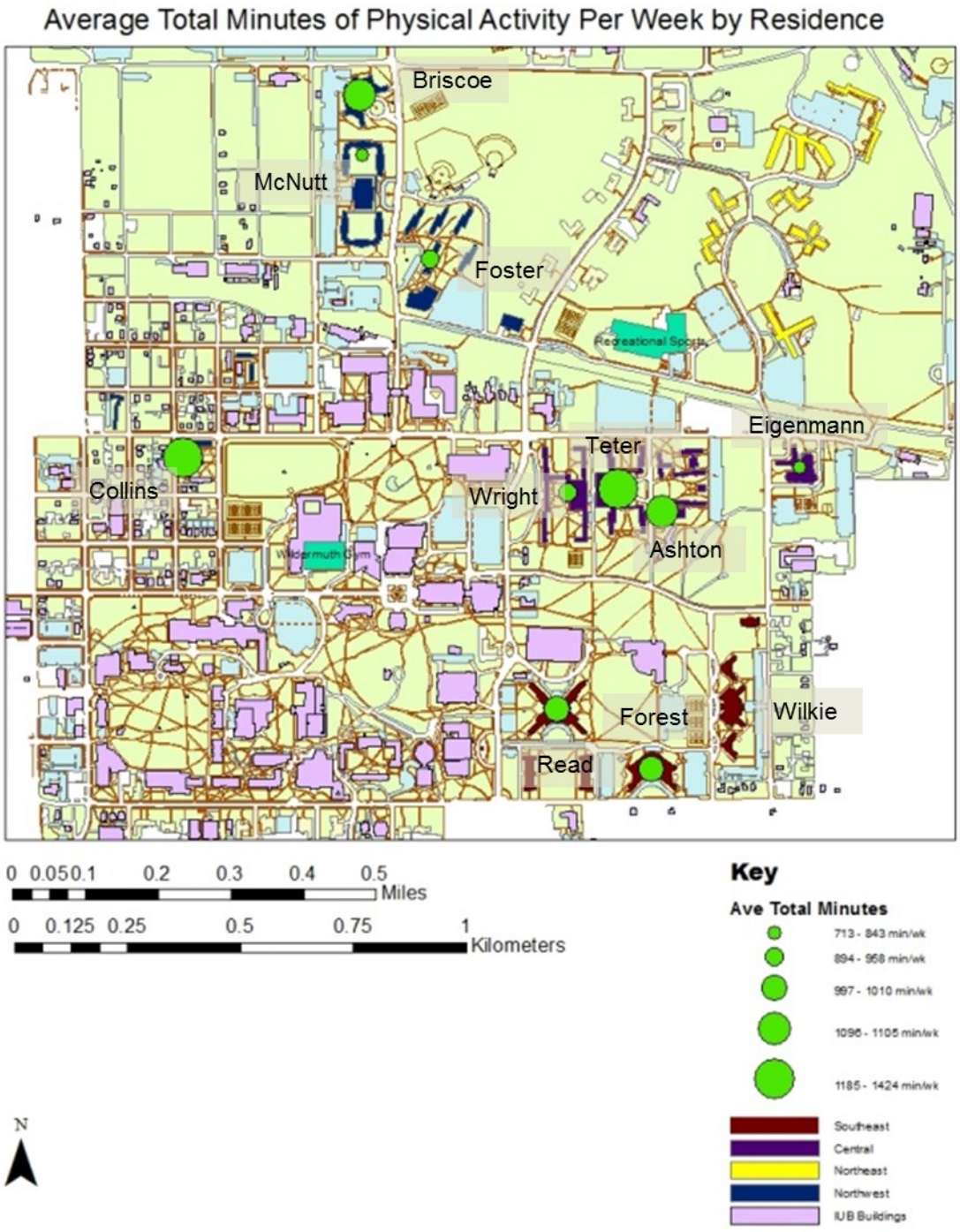
Table 6. Multiple Regression Analysis of Possible Factors Related to Facility Usage

	Model 1				Model 2			
Variables	***B***	**SE_B**	**Beta**	**P-value**	***B***	**SE_B**	**Beta**	**P-value**
Facility Usage	2.405	0.594		0.000	1.261	2.694		0.641
VPA	0.005	0.002	0.284	0.017	0.004	0.002	0.261	0.032
MPA	-0.001	0.002	-0.031	0.791	0.000	0.002	0.000	0.997
Walking	0.000	0.001	0.035	0.757	0.000	0.001	0.007	0.951
Vehicle Availability					0.590	0.781	0.755	0.453
BMI					0.078	0.078	0.94	0.375
Sex					0.662	0.662	-1.280	0.205

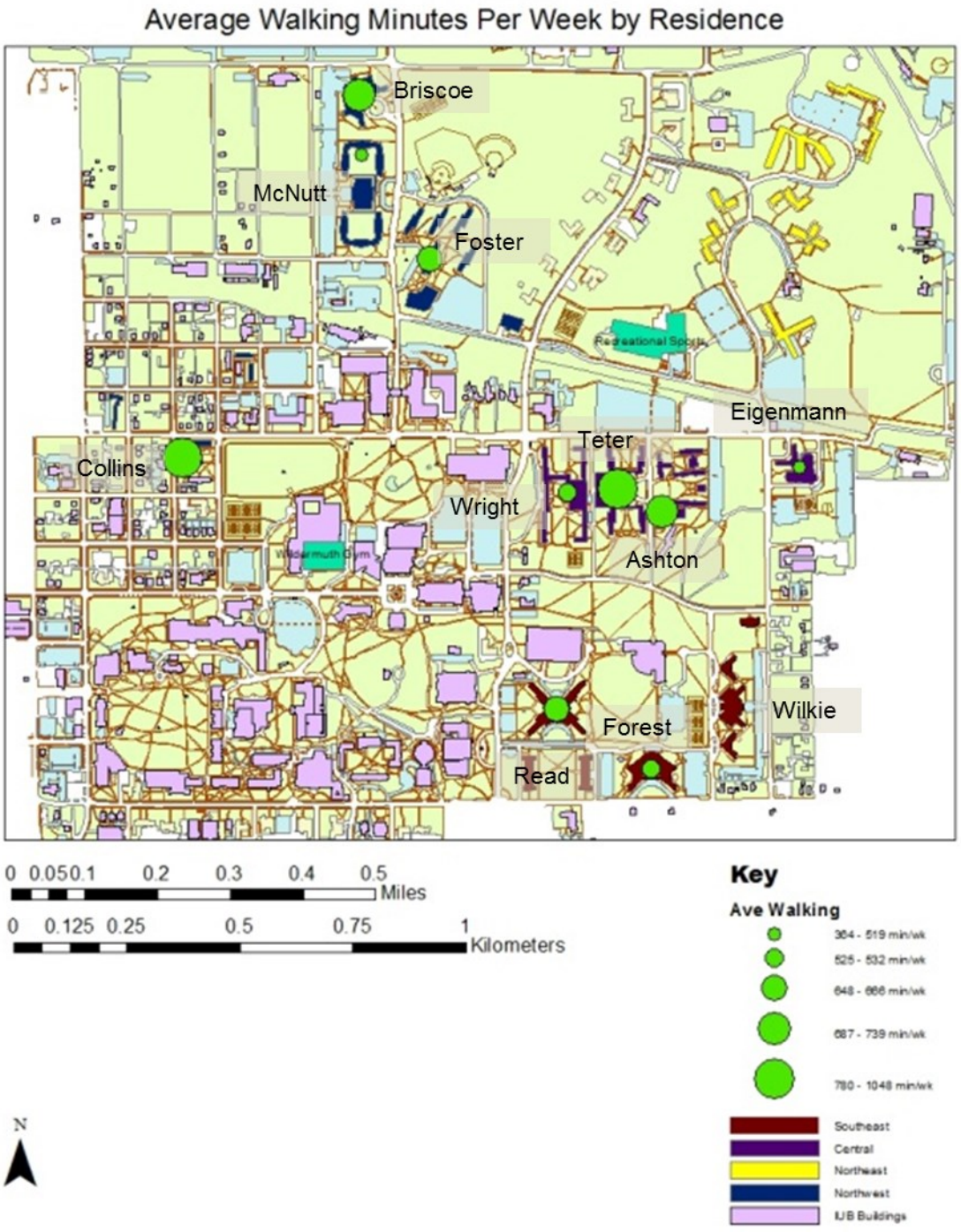
Note: Dependent Variable: Facility Usage

B=unstandardized regression coefficient; SE_B= Standard error of coefficient; Beta=standardized coefficient

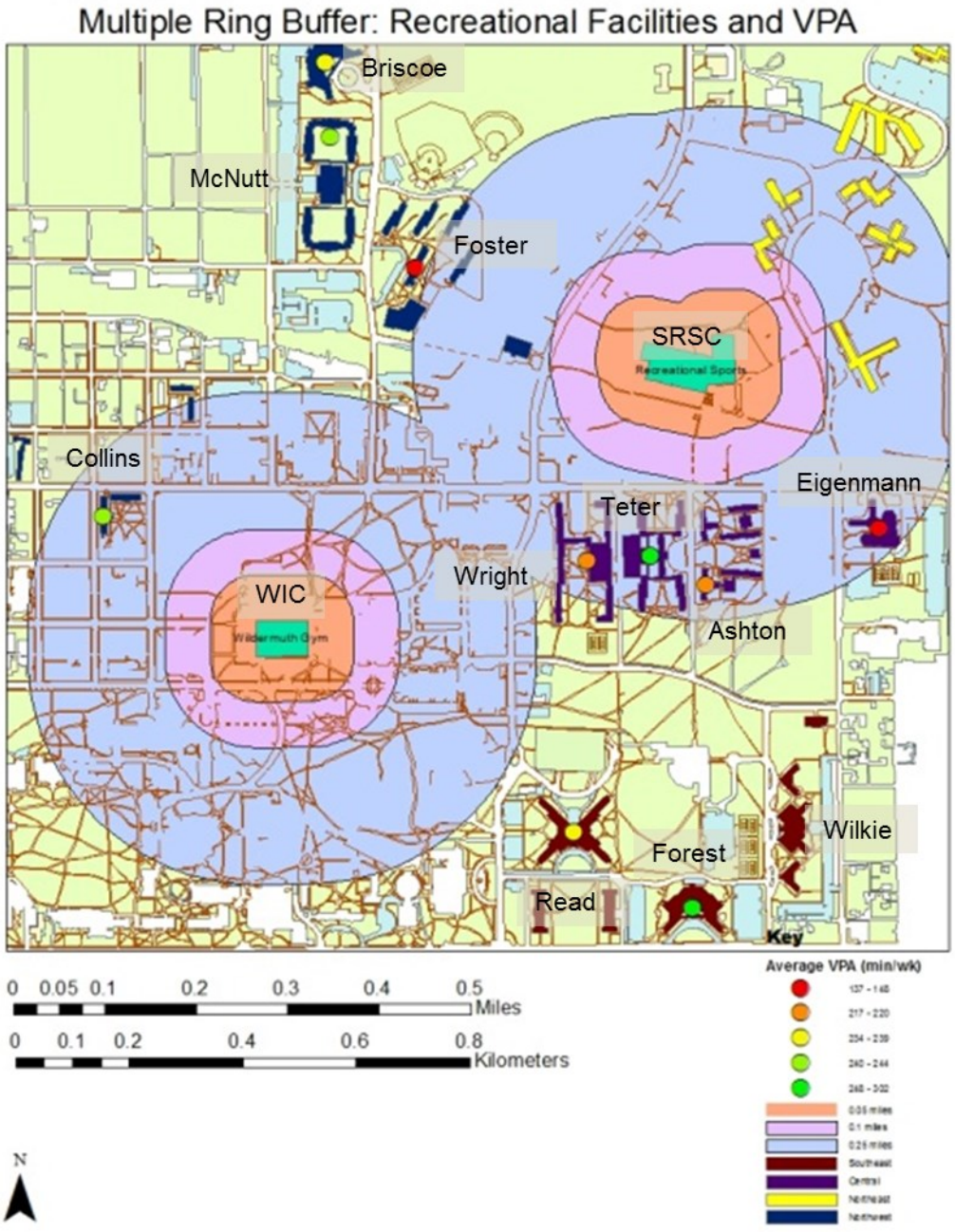
Map 1


Average Total Minutes of Physical Activity Per Week by Residence
Briscoe
McNutt
Foster
Recreational Sports
Eigenmann
Teter
Collins
Wright
Ashton
Wildermuth Gym
Forest
Wilkie
Read
0 0.050.1 0.2 0.3 0.4 0.5
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
N
Key
Ave Total Minutes
713 - 843 min/wk
894 - 968 min/wk
997 - 1010 min/wk
1096 - 1105 min/wk
1185 - 1424 min/wk
Southeast
Central
Northeast
Northwest
IUB Buildings

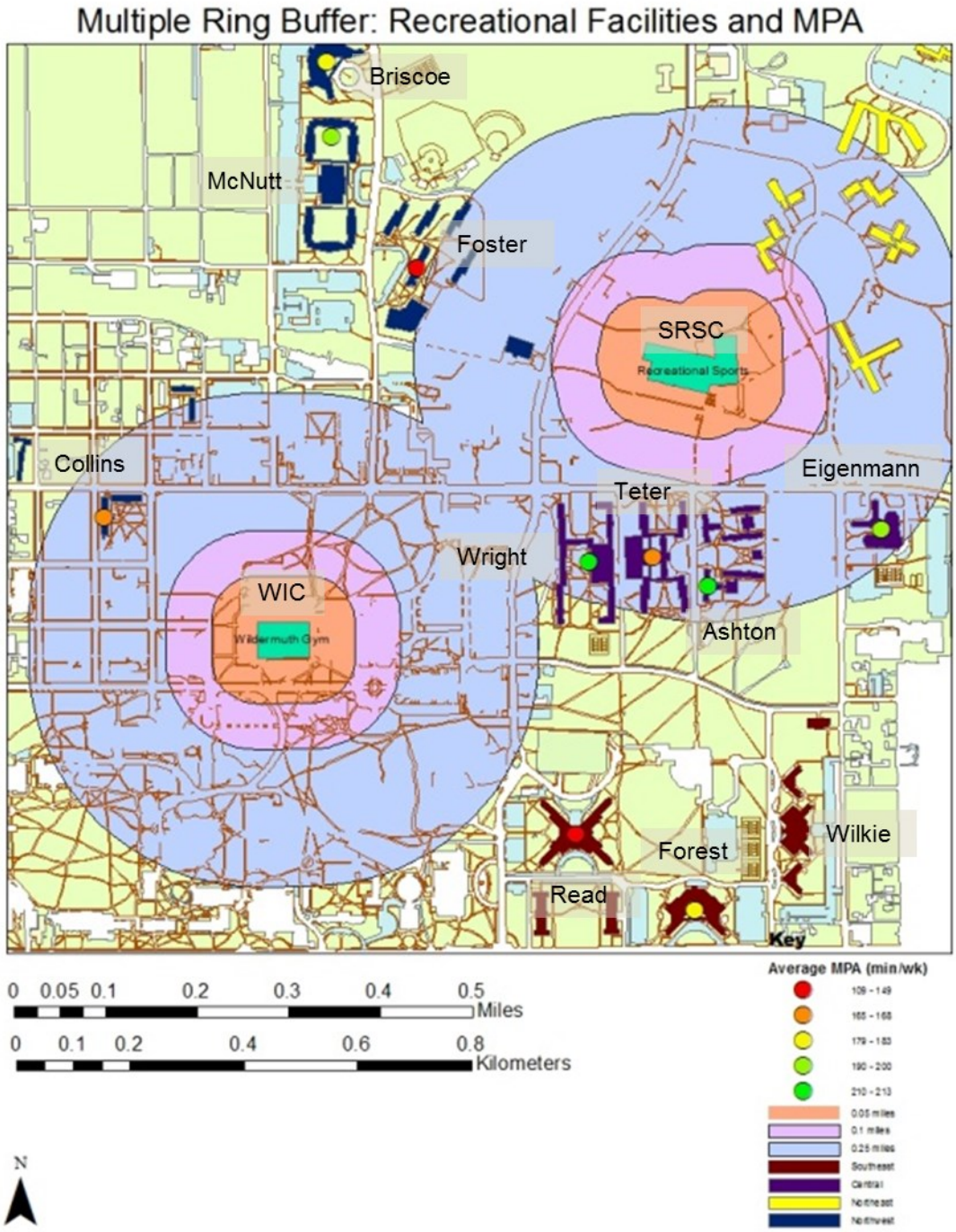
Map 2


Average Walking Minutes Per Week by Residence
Briscoe
McNutt
Foster
Eigenmann
Teter
Collins
Wright
Ashton
Wilkie
Forest
Read
0 0.050.1 0.2 0.3 0.4 0.5
Miles
0 0.125 0.25 0.5 0.75 1
Kilometers
N
Key
Ave Walking
364 - 519 min/wk
525 - 632 min/wk
648 - 666 min/wk
687 - 739 min/wk
780 - 1048 min/wk
Southeast
Central
Northeast
Northwest
IUB Buildings

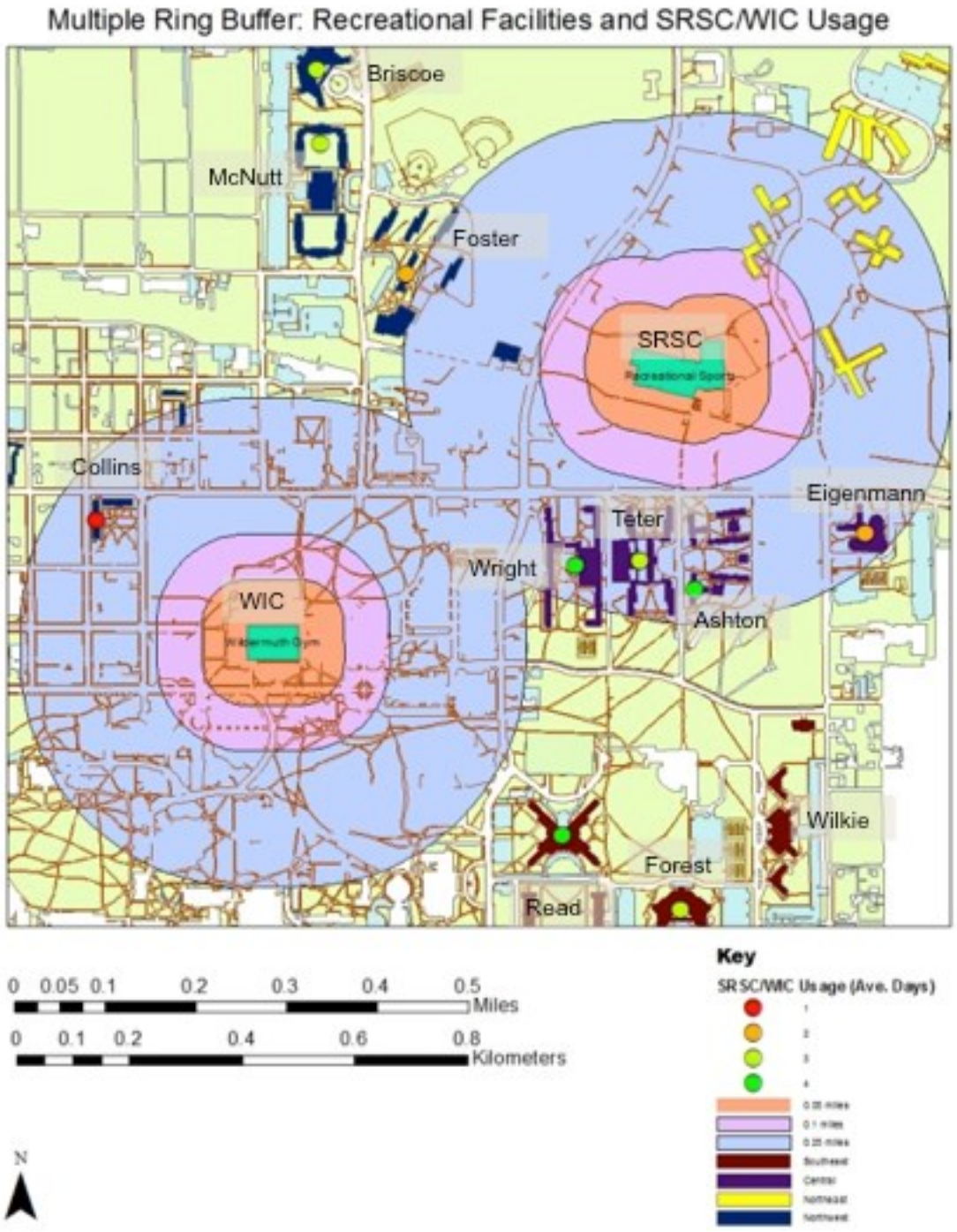
Map 3


Multiple Ring Buffer: Recreational Facilities and VPA
Briscoe
McNutt
Foster
SRSC
Recreational Sports
Collins
Eigenmann
Teter
Wright
WIC
Wildermuth Gym
Ashton
Wilkie
Forest
Read
Key
Average VPA (min/wk)
0 0.05 0.1 0.2 0.3 0.4 0.5
Miles
0 0.1 0.2 0.4 0.6 0.8
Kilometers
N

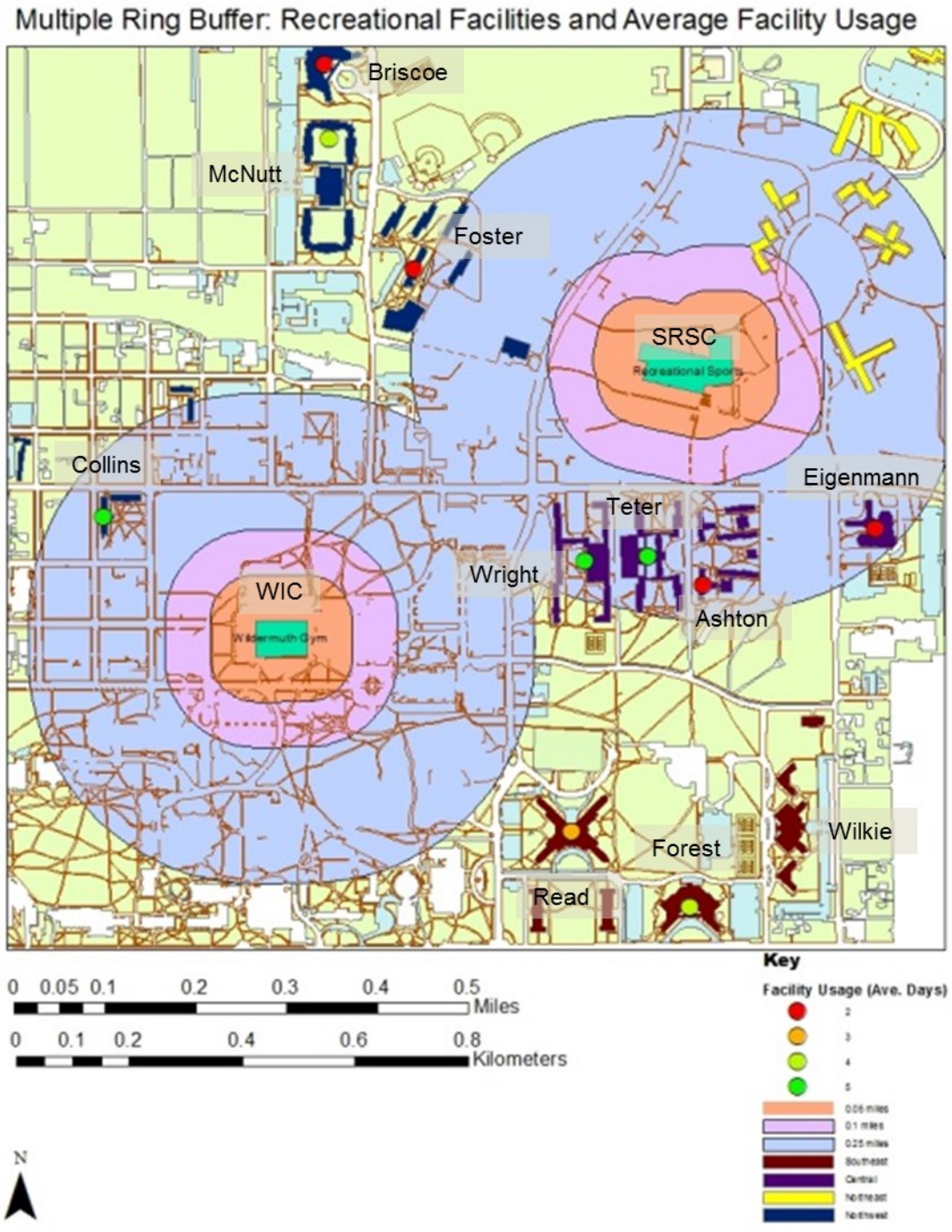
Map 4


Multiple Ring Buffer: Recreational Facilities and MPA
Briscoe
McNutt
Foster
SRSC
Recreational Sports
Collins
Eigenmann
Teter
Wright
WIC
Wildermuth Gym
Ashton
Forest
Wilkie
Read
Key
Average MPA (min/wk)
109 - 149
150 - 168
179 - 183
190 - 200
210 - 213
0.05 miles
0.1 miles
0.25 miles
Southeast
Central
Northeast
Northwest
0 0.05 0.1 0.2 0.3 0.4 0.5
Miles
0 0.1 0.2 0.4 0.6 0.8
Kilometers
N

Map 5


Multiple Ring Buffer: Recreational Facilities and SRSC/WIC Usage
Briscoe
McNutt
Foster
SRSC
Recreational Sports
Collins
Eigenmann
Teter
Wright
WIC
Ashton
Wilkie
Forest
Read
0 0.05 0.1 0.2 0.3 0.4 0.5
Miles
0 0.1 0.2 0.4 0.6 0.8
Kilometers
N
Key
SRSC/WIC Usage (Ave. Days)

Map 6


Multiple Ring Buffer: Recreational Facilities and Average Facility Usage
Briscoe
McNutt
Foster
SRSC
Recreational Sports
Collins
Eigenmann
Teter
Wright
WIC
Widermuth Gym
Ashton
Wilkie
Forest
Read
0 0.05 0.1 0.2 0.3 0.4 0.5
Miles
0 0.1 0.2 0.4 0.6 0.8
Kilometers
N
Key
Facility Usage (Ave. Days)
2
3
4
5
0.05 miles
0.1 miles
0.25 miles
Southeast
Central
Northeast
Northwest

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Appendix 1: Survey Instrument Spring 2013

Association Between Freshman Residence and Physical Activity
IRB Study # 1302010741

INDIANA UNIVERSITY STUDY INFORMATION SHEET FOR

Association Between Freshman Residence and Physical Activity

You are invited to participate in a research study of physical activity and campus residence. You were selected as a possible subject because [you were identified as an undergraduate college student currently enrolled at Indiana University. We ask that you read this form and ask any questions you may have before agreeing to be in the study.The study is being conducted by Jeanne D. Johnston and Rickie Lee Marker-Hoffman from the School of Public Health Bloomington, Department of Kinesiology.

STUDY PURPOSE

The purpose of this study is to investigate the relationship between physical activity and residence of first year freshman students living on campus at Indiana University Bloomington (IUB). Specifically we are interested in obtaining information about how physically active you are, where and how often you participate in physical activity, and how you travel around campus. In addition, we are interested in obtaining a description of where you live as it relates to physical activity opportunities and preference.

NUMBER OF PEOPLE TAKING PART IN THE STUDY:

If you agree to participate, you will be one of 7,570 subjects who are eligible to participate in this study

PROCEDURES FOR THE STUDY:

If you agree to be in the study, you will do the following things:

You will be asked to complete a survey that will take about 15 minutes of your time to complete. You will be asked to complete this survey one time on a computer. You will be asked demographic information in addition to information about your residence on campus, physical activity participation, and transportation.

RISKS OF TAKING PART IN THE STUDY:

The risks associated with this project include being uncomfortable answering the questions included in the survey and a possible loss to confidentiality. If you feel uncomfortable answering any questions, you may skip any question or withdraw from the study at any point. Every effort will be utilized to keep data de-identified and confidential. Username will be stored separately and will only be used to notify a participant of being selected for the drawing.

BENEFITS OF TAKING PART IN THE STUDY:

The benefits to participation that are reasonable to expect are to help researchers understand physical activity participation at Indiana University's Bloomington campus including where freshman students participate in physical activity and how they travel to and from locations on campus. This will provide insight into the preferences and environment that may impact freshman students' physical activity participation. This will also provide insight into overall physical activity of this population. Participants may also have the opportunity to learn about their physical activity behaviors and gain awareness of physical activity opportunities on campus.

ALTERNATIVES TO TAKING PART IN THE STUDY:

Participation in this study is voluntary. Instead of being in the study, you may refuse to participate without penalty or withdraw from the study at any time without penalty. If you withdraw from the study before data collection is complete your data will be destroyed.

CONFIDENTIALITY

Efforts will be made to keep your personal information confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Your identity will be held in confidence in reports in which the study may be published and databases

Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the study investigator and his/her research associates, the Indiana University Institutional Review Board or its designees, and (as allowed by law) state or federal agencies, specifically the Office for Human Research Protections (OHRP), who may need to access your research records.

PAYMENT

By completing this survey, you will be included in a random drawing to receive a $50 gift card to iTunes. One name will be randomly chosen for every 50 students that complete the survey. Students will be notified via email when they are randomly chosen and the iTunes gift card will be emailed to the student.

CONTACTS FOR QUESTIONS OR PROBLEMS

For questions about the study, contact the researcher Jeanne D. Johnston at 812-855-5073. For questions about your rights as a research participant or to discuss problems, complaints or concerns about a research study, or to obtain information, or offer input, contact the IU Human Subjects Office at (317) 278-3458 or [for Indianapolis] or (812) 856-4242 [for Bloomington] or (800) 696-2949.

VOLUNTARY NATURE OF STUDY

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time. Leaving the study will not result in any penalty or loss of benefits to

which you are entitled. Your decision whether or not to participate in this study will not affect your current or future relations with Indiana University

If you would like to participate in this study, click the forward arrow (>>) below to begin the survey.

Participation Eligibility
The following questions are to determine if you are eligible to participate in this study.

Are you 18 years or older?
❍ Yes
❍ No

If No Is Selected, Then Skip To Thank you for your interest, however ...

Are you currently a freshman?
❍ Yes
❍ No

If No Is Selected, Then Skip To Thank you for your interest, however ...

Are you currently on an intercollegiate/club sports team at IU?
❍ Yes
❍ No

If No Is Selected, Then Skip To Thank you for your interest, however ...

How many credit hours were you enrolled in last semester?
❍ less than 12
❍ 12 or more

If less than 12 Is Selected, Then Skip To Thank you for your interest, however ...

How many credit hours are you currently enrolled in?
❍ less than 12
❍ 12 or more

If less than 12 Is Selected, Then Skip To Thank you for your interest, however ...

Do you currently live on campus in University provided student housing?
❍ Yes
❍ No

If No Is Selected, Then Skip To Thank you for your interest, however ...

Is this your first year (academic year 2012-2013) residing on campus through University provided housing?
❍ Yes
❍ No

If No Is Selected, Then Skip To Thank you for your interest, however ...

Did you graduate from high school in the spring/summer of 2012?
❍ Yes
❍ No

If No Is Selected, Then Skip To Thank you for your interest, however ...

You are eligible to participate in this study.

By completing this survey you will be placed in a drawing for a 1 in 50 chance to win a $50 gift card to iTunes.
Please enter your IU email. If you are selected, you will be contacted via email using this email. Only respondents who use their IU email will be eligible to win the drawing. Only one response per IU email is permitted.

Physical Activity
The questions below are about your physical activity. When answering these questions think about a typical week over the past Spring Semester 2013.

Think about a typical Spring week during the past semester when the weather was nice. On how many days did you do vigorous physical activities like aerobics, running, or fast bicycling? Think about only those physical activities that you did for at least 10 minutes at a time.

	0	1	2	3	4	5	6	7
Days per week	❍	❍	❍	❍	❍	❍	❍	❍

How much time in total did you usually spend on ONE of those days doing vigorous physical activities?

	Enter values in boxes provided. e.g. 1 hour and 30 minutes
Hours Minutes	

Again think about a typical Spring week during the past semester when the weather was nice.

On how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, jogging, swimming, or doubles tennis? Think about only those physical activities that you did for at least 10 minutes at a time. Do not include walking.

	0	1	2	3	4	5	6	7
Days per week	❍	❍	❍	❍	❍	❍	❍	❍

Continue thinking about a typical spring week during the past semester when the weather was nice. On how many days did you walk for at least 10 minutes at a time? This includes walking at work and at home, walking to travel from place to place, and any other walking that you did solely for recreation, sport, exercise or leisure.

	0	1	2	3	4	5	6	7
Days per week	❍	❍	❍	❍	❍	❍	❍	❍

How much time in total did you usually spend on ONE of those days walking?

	Enter values in boxes provided. e.g. 1 hour and 30 minutes
Hours Minutes	

Did you participate in sports in high school? (Include all sport/team activities including varsity, recreational leagues, dance teams etc.)

❍ Yes
❍ No

Have you participated in sport, team or instructor lead activities during your freshman year of college? Select all that apply.

- ❑ College level sports team
- ❑ Intramurals
- ❑ Physical activity classes taken for school credit (i.e. basketball, fitness and jogging, racquetball, ballet etc.)
- ❑ Group exercise classes offered on campus for a fee (i.e. group swim instruction, yoga, cycling)
- ❑ Group exercise classes offered on campus for free (i.e. Zumba, Kickboxing, Cardio Core, etc.)

Answer If Did you participate in sport, team or instructor lead act... Intramurals Is Selected

How many intramural sports have you participated in?

Answer If Have you participated in sport, team or instructor lead a... Physical activity classes taken for school credit (i.e. basketball, fitness and jogging, racquetball, ballet etc.) Is Selected

How many physical activity classes for credit have you taken while attending Indiana University?

Answer If Did you participate in sport, team or instructor lead act... Group exercise classes offered on campus for a fee (i.e. group swim instruction, yoga, cycling) Is Selected

How many group exercise classes offered on campus for a fee have you participate in? (e.g. group swim instruction, yoga, cycling etc)

Answer If Have you participated in sport, team or instructor lead a... Group exercise classes offered on campus for free (i.e. Zumba, Kickboxing, Cardio Core, etc.) Is Selected

How many group exercise classes offered on campus for free have you participate in? (e.g. Zumba, Kickboxing, Cardio Core etc)

During a typical week this semester, how many days per week do you use the facilities at the Student Recreational Sports Center (SRSC)?
_____ Days per week

During a typical week this semester, how many days per week do you use the facilities at the Wildermuth Intramural Center (WIC)?
_____ Days per week

During a typical week this semester, how many days per week do you use onsite facilities available at your residence?
_____ Days per week

During a typical week this semester, how many days per week do you use your own personal exercise equipment? (i.e. a road bike, roller blades, exercise videos etc.)
_____ Days per week

During a typical week, where do you prefer to participate in physical activity?
Please rank the following where 1 is your preferred location and 7 is your least preferred.
_____ Campus gym (SRSC or WIC)
_____ Outside
_____ Dorm room
_____ Onsite residence facility
_____ During scheduled class time (i.e. if taking class an activity class for credit)
_____ Private gym or fitness center not associated with Indiana University
_____ Other

Residence

The questions in this section are about your current campus residence for Spring Semester 2013.

What residence center do you currently reside in?

- ❍ 3rd & Union Apts.
- ❍ Ashton
- ❍ BBHN (Bicknell, Banta, Hepburn and Nutt)
- ❍ Briscoe
- ❍ Campus View
- ❍ Collins
- ❍ Eigenmann
- ❍ Evermann Apts.
- ❍ Forest
- ❍ Foster
- ❍ McNutt
- ❍ Read
- ❍ Redbud Hill
- ❍ Teter
- ❍ Tulip Tree Apts.
- ❍ Union Street Center
- ❍ University East Apts.
- ❍ Wilkie
- ❍ Wright
- ❍ Other _____

What residence center building or tower do you live in?

- ❍ Bant
- ❍ Beck
- ❍ Bicknell
- ❍ Bocobo
- ❍ Boisen
- ❍ Bordner
- ❍ Brown Hall
- ❍ Bryan
- ❍ Campbell
- ❍ Clark
- ❍ Cravens
- ❍ Crone
- ❍ Curry
- ❍ Dejoya
- ❍ Delgado
- ❍ Dewey
- ❍ Dodds
- ❍ Dunn
- ❍ Edmondson
- ❍ Elkins
- ❍ Elliot
- ❍ Ferguson
- ❍ Greene Hall
- ❍ Gucker
- ❍ Hall
- ❍ Harding
- ❍ Harney
- ❍ Harper
- ❍ Hepburn
- ❍ Hershey
- ❍ Hillcrest Apartment
- ❍ Hummer
- ❍ Jenkins
- ❍ Jenkinson
- ❍ Johnston
- ❍ Landes
- ❍ Lowe
- ❍ Magee
- ❍ Martin
- ❍ Moffat
- ❍ Nichols
- ❍ Nutt
- ❍ Parks
- ❍ Rabb
- ❍ Rollins
- ❍ Ruter
- ❍ Shea
- ❍ Shoemaker
- ❍ Smith
- ❍ Stemple

- ❍ Stockwell
- ❍ Thompson
- ❍ Todd
- ❍ VOS
- ❍ Wissler
- ❍ Other

What floor do you live on?

- ❍ 1st
- ❍ 2nd
- ❍ 3rd
- ❍ 4th
- ❍ 5th
- ❍ 6th
- ❍ 7th
- ❍ 8th
- ❍ 9th
- ❍ 10th
- ❍ 11th
- ❍ 12th
- ❍ 13th
- ❍ 14th
- ❍ 15th
- ❍ 16th
- ❍ 17th
- ❍ 18th
- ❍ 19th
- ❍ 20th
- ❍ 21st
- ❍ 22nd
- ❍ 23rd
- ❍ 24th

How long have you lived in your current residence hall?

- ❍ 0 months
- ❍ 1 month
- ❍ 2 months
- ❍ 3 months
- ❍ 4 months
- ❍ 5 months
- ❍ 6 months
- ❍ 7 months
- ❍ 8 months
- ❍ 9 months
- ❍ 10 months

Think about a typical week, how often do you use the elevator in your residence hall?

	Never	Rarely	Sometimes	Most of the time	Always
Move the bar to indicate how often you use the elevator	❍	❍	❍	❍	❍

Think about a typical week, how often do you use the stairs in your residence hall?

	Never	Rarely	Sometimes	Most of the time	Always
Move the bar to indicate how often you use the stairs	❍	❍	❍	❍	❍

Do you have a fitness facility within your residence center that you have access to?

❍ Yes
❍ No
❍ Unsure

If Yes Is Selected, Then Skip To Is the fitness facility in your resid...If No Is Selected, Then Skip To TransportationThese questions are abo...If Unsure Is Selected, Then Skip To TransportationThese questions are abo...

Is the fitness facility in your residence building or tower?

❍ Yes
❍ No
❍ Unsure

Transportation
These questions are about how you go to and from locations on campus.
Think about a typical week during Spring Semester 2013.

How often (% of your time) do you travel to the following locations from your residence center or building by active transportation (such as walking, biking, longboarding, skateboarding etc) as compared to a bus/car?

Click the space that corresponds with your choice for each location where:
0 indicates you never use active transportation
50 indicates you use active transportation and bus/car equally
100 indicates you always use active transportation

_____ Assembly Hall
_____ Ballantine Hall
_____ Edmondson Dining Room
_____ Gresham Food Court
_____ IMU
_____ Jordan Hall
_____ Landes Dining Room at Read
_____ Sample Gates
_____ Kelley School of Business
_____ School of Education
_____ School of Fine Arts
_____ School of Public Health
_____ Jacobs School of Music
_____ SRSC
_____ Swain Hall
_____ Wells Library
_____ WIC (Wildermuth)
_____ Write Food Court

What is your preferred mode of transportation around campus?
❍ Bus
❍ Personal Vehicle
❍ Bicycle
❍ Walk
❍ Skate board and/or long board
❍ Roller blade
❍ Get a ride
❍ Other _____

Demographic Information

What is your sex?
❍ Male
❍ Female

How old are you? (Please type your age in years e.g. 18)

What is your current major? (Please type in your current major, if undecided please type "undecided")

What is your weight in pounds? (_____ lb)

What is your height in feet and inches? (i.e. 5 ft 4 in)

	Please type your height in the boxes provided.
Feet Inches	

Do you have a personal vehicle on campus for the current semester?
- ❍ Yes
- ❍ No

Thank you for taking this survey. You will be contacted by email via your IU email you provided at the beginning of the survey if you are selected as a drawing winner.
If Thank you for taking this s... Is Displayed, Then Skip To End of Survey

Thank you for your interest, however at this time you are not eligible to participate in this study.

Appendix 2: Initial Email Recruitment

TO: Student
From Jeanne D. Johnston and Rickie Lee Marker-Hoffman
RE: Chance to win a $50 iTunes gift card

IUB Student—

We need *your* help in order to understand physical activity habits among first year IU freshman living on campus.

I am sending this email on behalf of researchers at Indiana University Department of Kinesiology. We are sending this survey to Indiana University students identified through student list servs and classes.

The purpose of this study is to better understand participation in physical activity based on your campus residence. The results will be used to inform future IU programming and policies related to physical activity opportunities for IU students.

In order to be eligible to participate in this study, you must be a first year freshman living on campus in University provided housing.

You are not required to participate in any activities other than this survey. This survey requires approximately 10 minutes of your time. Your personal information including your IU email will not be used or shared.

Benefits of participation:

- Students that complete the survey will be included in a **random drawing to receive a $50 iTunes gift card.** One name will be randomly chosen for every 50 students that complete the survey. Only one survey per IU email address is permitted. Only survey respondents that use their IU email address will be included in the drawing.
- Reflect about your physical activity participation and potentially learn about physical activity opportunities on campus.
- Opportunity to help future IUB students by providing information for future programming and new facilities to support your physical activity behaviors.

Questions about this study? Email Rickie Lee Marker-Hoffman (rickmark@indiana.edu) or Dr. Jeanne Johnston (jdjohnst@indiana.edu) 812-855-5073.
Interested in participating? Click on the survey link below:
https://iuhealth.qualtrics.com/SE/?SID=SV_3eDbXlMIbhlrGCx
Thank you!

Appendix 3: Follow Up Email Recruitment

TO: Student
From Jeanne D. Johnston and Rickie Lee Marker-Hoffman
RE: You can still win a $50 iTunes gift card by completing this survey

IUB Student--
A little while ago you were sent an email telling you about a project that is being conducted within freshman college students. I am sending this email on behalf of researchers at Indiana University Depart1ment of Kinesiology to remind you of this project.

We need *your* help in order to describe physical activity habits among first year IU freshman living on campus at Indiana University-Bloomington Campus. We are sending this survey to Indiana University students identified through student list servs and classes.

The purpose of this study is to better understand participation in physical activity based on your campus residence. The results will be used to inform future IU programming and policies related to physical activity opportunities for IU students.

In order to be eligible to participate in this study, you must be a first year freshman living on campus in University provided housing.

You are not required to participate in any activities other than this survey. This survey requires approximately 10 minutes of your time. Your personal information including your IU email will not be used or shared.

Benefits of participation:

- Students that complete the survey will be included in a **random drawing to receive a $50 iTunes gift card.** One name will be randomly chosen for every 50 students that complete the survey. Only one survey per IU email address is permitted. Only survey respondents that use their IU email address will be included in the drawing.

- Reflect about your physical activity participation and potentially learn about physical activity opportunities on campus.

- Opportunity to help future IUB students by providing information for future programming and new facilities to support your physical activity behaviors.

Questions about this study? Email Rickie Lee Marker-Hoffman (rickmark@indiana.edu) or Dr. Jeanne Johnston (jdjohnst@indiana.edu) 812-855-5073.

Interested in participating? Click on the survey link below:

https://iuhealth.qualtrics.com/SE/?SID=SV_3eDbXlMIbhlrGCx

Thank you!

RICKIE LEE MARKER-HOFFMAN | CURRICULUM VITAE

Email: rickielee.markerhoffman@gmail.com

EDUCATION & TRAINING

Indiana University Bloomington, IN

Masters in Physical Activity, Fitness, and Wellness Management May 2014

- Thesis: Association Between Freshman Residence and Physical Activity
- Advisor: Dr. Jeanne D. Johnston, Department of Kinesiology
- Relevant Coursework: Corporate Fitness and Wellness, Physical Activity and Health, Obesity/Body Composition, Models and Theories of Health Behavior, Public Health Statistics, Research Methods, Exercise and Physical Activity for People with Disabilities, Finance and Budgeting, Organization and Administration of Public Health Programs, Assessment and Planning in Public Health.

Masters in Public Health Concentration in Epidemiology May 2013

- Relevant Coursework: Epidemiology, Advanced Epidemiology, Social, Chronic, and Infectious Disease Epidemiology, Advanced Epidemiological Methods, Health Program Evaluation.

Boise State University Boise, ID

Bachelor of Science May 2008

Major: Health Studies

Minors: Psychology, Dance

- Relevant Coursework: Applied Anatomy, Anatomy and Physiology, Exercise Physiology, Chemistry, Microbiology, Nutrition, Epidemiology, Research Methods, Health Delivery Systems, Counseling Techniques for Health Professionals, Health Law and Ethics.

ACSM/NSPAPPH

Physical Activity in Public Health Specialist May 2014

PROFESSIONAL EXPERIENCE

Hoosier Energy REC, Inc. Bloomington, IN

Worksite Wellness Coordinator August 2011 – Present

- Strategic planning for upcoming initiatives, incentive structure, and overall program utilizing data from health screenings and surveys to develop appropriate program content, goals, and relevant policies
- Developed annual survey process that increased from a 20% response rate to 89%
- Manage and assess wellness initiatives to report effectiveness and direction of the wellness program through publications and executive reports
- Increased program scope and employee engagement in wellness programming initiatives such as the annual health screening from 53%-80% through an effective and comprehensive communication and marketing plan including emails, flyers, and face-to-face meetings and presentations
- Coordinate resources and collaborate with partners for successful design and effective delivery of wellness initiatives
- Increase scope of program to engage 475 employees and 30 wellness committee members at remote worksites through diverse opportunities and greater program accessibility
- Analyzed and interpreted data to develop a worksite nutrition policy using current research and population data
- Provide necessary evidence for implementing guidelines to ensure a supportive environment for adopting healthier eating behaviors common to nutritional risk factors related to chronic disease
- Manage wellness program elements including a comprehensive communication strategy, web portals, onsite information kiosks, employee group meetings, and provide guidance to wellness committee members to increase awareness and engagement in the program

Hoosier Energy REC, Inc. Bloomington, IN
Market Research and Analyst Intern, Wellness April 2011 – August 2011

- Develop content, managed, and determined effective delivery process for promotional and informational materials including web and print based content and materials associated with quarterly wellness topics
- Educated and promoted the wellness program to small groups of employees to increase employee awareness and participation in the program

Service Team Of Professionals, Property Restoration Franchise Bloomington, IN
Administrative Assistant May 2010 – August 2011

- Complete office management including ownership of company website updates as well as daily correspondence with clients, brokers, and team leaders
- Created marketing materials and business plan

The Greater Bloomington Chamber of Commerce Bloomington, IN
Healthy Business Bloomington Intern May 2010 – August 2010

- Assisted with administration of new Healthy Business Bloomington program
- Duties included assisting with marketing, assessing elements of the current program, contacting local businesses about the program, and supporting them with the application process
- Help develop program materials such as program application and related communications

LEADERSHIP AND TEACHING

Indiana University, Department of Kinesiology Bloomington, IN
Associate Instructor, Fitness and Jogging and Personal Fitness Lab August 2011 – May 2012

- Wrote class syllabi, created course schedule and lesson plans and any related materials
- Created assignments and grading rubrics to facilitate students learning and expectations
- Used Oncourse to organize and manage course including student assignments, grades, and communications

RESEARCH EXPERIENCE

Indiana University School of Public Health Bloomington, IN
Research Assistant August 2008 – Present

- Managed and completed research projects including defining the scope of the project, developing assessment tools using Survey Monkey and Qualtrics programs, data collection, analysis and dissemination of results
- Coordinated 3 major studies over one year in length with more than 500 college students
- Developed a multi-national survey on health related indices
- Researched and wrote procedures for research projects and created data collection sheets and codebooks
- Organized and facilitated testing schedule and data collection for research projects, as well as trained researchers on procedures
- Data management, analysis, and interpretation for multiple data sets using excel and SPSS
- Utilized GIS and spatial statistics using ArcMap

GRANTS

Community Foundation of Bloomington and Monroe County Bloomington, IN
Grant recipient ($1,000) Summer 2009

- Wrote grant to advocate for a new program to increase physical activity in local youth
- Designed, planned, organized, and implemented a walking incentive program "It Pays to Play Each Day" to motivate 80 local Elementary students to increase their physical activity over 6 weeks
- Collaborated with local community stakeholders associated with youth programming to determine where the program would be most beneficial for the community

SERVICE

Active Living Coalition Bloomington, IN
Research Task Force Volunteer September 2013- Present

- Helped develop and administer a survey to community coalition members
- Organized and cleaned data for the research task force
- Helped to evaluate data and report findings back to the coalition

Worksite Wellness Alliance of Southern Indiana Bloomington, IN
Member May 2013- Present

- Help facilitate and organize quarterly meetings
- Collaborate and network with organizations in delivering worksite wellness initiatives

PUBLICATIONS

Johnston, J.D. & Marker-Hoffman, R.L. (2013) Technology as a means to influence physical activity. *Health Education Monograph Series: Physical Activity and Public Health*, 30(1), 54-58.

Johnston, J. D., Massey, A. P., & Marker-Hoffman, R. L. (2012). Using an alternate reality game to increase physical activity and decrease obesity risk of college students. *Journal of Diabetes Science and Technology, 6*(4), 828-838.

PUBLISHED ABSTRACTS

Johnston, J., Lindeman, A., Marker-Hoffman, R., & Hinman, M. (2009). Body composition and cardiovascular risk factors within college-aged students: 1725. *Medicine & Science in Sports & Exercise, 41*(5), 109.

Marker-Hoffman, R., Hinman, M., Lindeman, A., Johnston, J. (2010). Sex differences in pedometer determined physical activity within first year college students: 2398. *Medicine & Science in Sports & Exercise, 42*(5), 612.

Marker-Hoffman, R. L., Johnston, J. D., Agley, J., Gassman, R., Middlestadt, S. E., & Puymbroeck, M. V. (2011). Walking and body mass index patterns in a college student population: 2812: Board# 111 June 3 3:30 PM-5: 00 PM. *Medicine & Science in Sports & Exercise, 43*(5), 793.

Marker-Hoffman, R., Johnston, J., Lindeman, A., & Hinman, M. (2009). Self reported weight category vs. actual weight category within college-aged students: 1723. *Medicine & Science in Sports & Exercise, 41*(5), 108.

HONORS AND AWARDS

School of Public Health Bloomington Travel Award Spring 2011 & 2012
Dean's List with Honors Spring 2008, Spring/Fall 2006, Spring 2005
Robert E. Lee Promise Scholarship 2004-2006

PROFESSIONAL MEMBERSHIPS

American College of Sports Medicine